ROTUNDA

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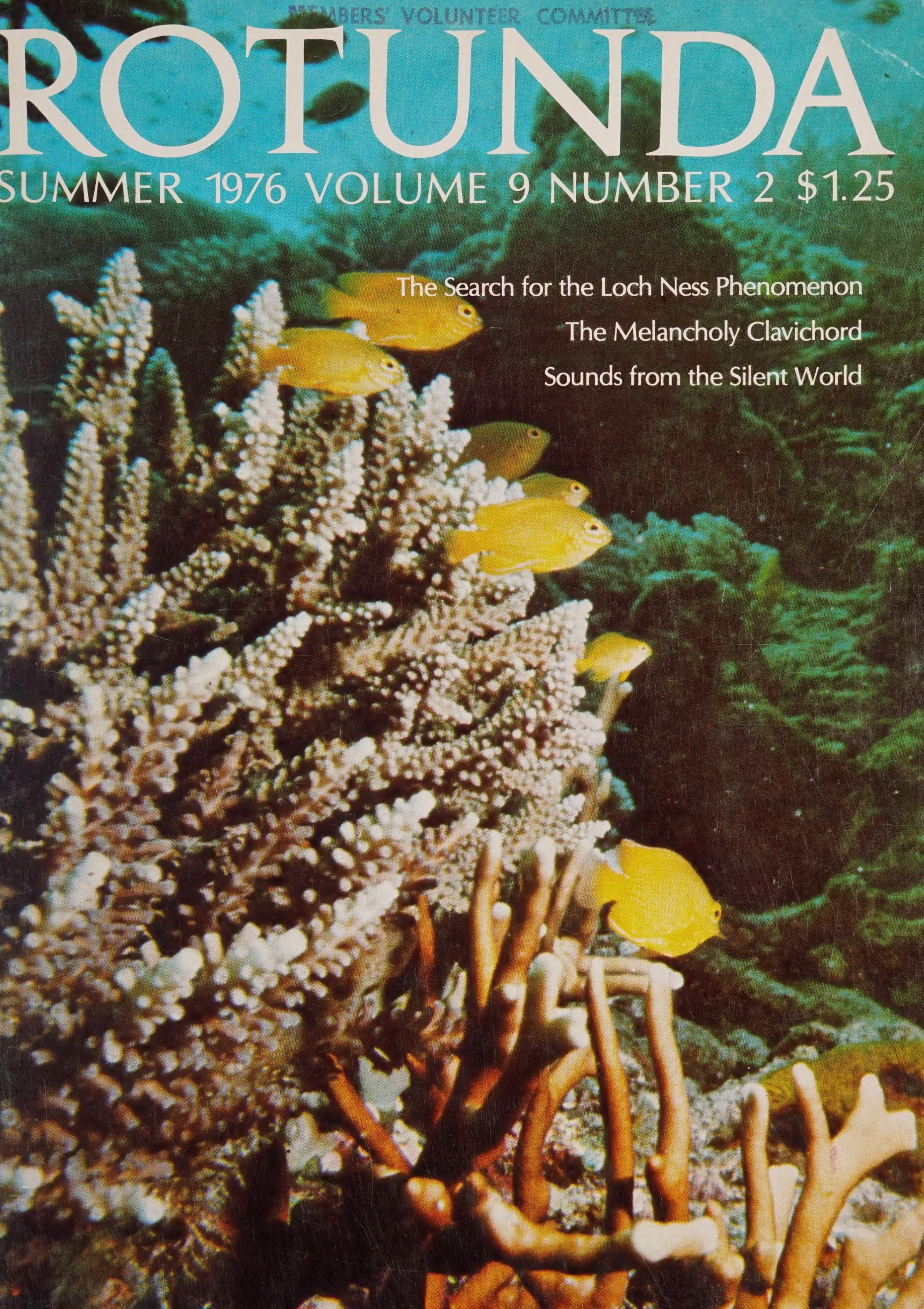
The Search for the Loch Ness Phenomenon

The Melancholy Clavichord

Sounds from the Silent World



ROTUNDA

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Yellow damselfish (Pomacentrus Molluccensis) *from tropical oceania (Palau). See page 4.*

The Main Building
100 Queen's Park
Information 978-3690

Sigmund Samuel Canadiana Building
14 Queen's Park Crescent West

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Focus

On Oriental Rugs in the ROM

Veronika Gervers

Although some carpets have always been on display in the galleries of the European and Far Eastern departments, the current exhibition "From the Marmora to the Great Wall of China" (March 5 – June 28) is the first in which the ROM's oriental rug collection has been shown to the public. A select group of forty-odd carpets represents the different rug-producing regions of the East, with examples from city and town workshops as well as from village weavers and nomads. Special attention has been given to representing technical aspects, so that flat weaves, felt, and embroidered rugs are presented along with pile carpets. Garments and photographs provide additional colour and show scenes from the life of rug-producing peoples.

The origins of the Museum's rug collection go back to the early years of this century, when a number of pieces were acquired by the first director, Dr. C. T. Currelly. In the 1920s, the George Crofts Collection contributed mainly Far Eastern material. In 1941, Miss Amice Calverley's generous donation of Romanian rugs formed the basis for the flat-woven group from the Balkans. In recent years, nomadic material has been acquired from Anatolia and Afghanistan, and a project on felt making, supported by the Canada Council, stimulated research into the historical origins of knotted and flat-woven rugs. (See M. and V. Gervers, "Felt-making craftsmen of the Anatolian and Iranian Plateaux", *Textile Museum Journal*, IV/I, December 1974, pp. 14-29.)

Since special research has never been directed towards the ROM's rugs, systematic collecting has not taken place. The earliest carpets are from the 18th century, and most examples date from the 19th and early 20th centuries. Nevertheless, the collection has many strong points. The fine Turkmen bags from Western Turkestan are not only outstanding, but rare indeed. Although few in number, the exquisite rugs from Eastern Turkestan are also of considerable importance. The Chinese carpets, which include numerous old pieces, form a comprehensive group. The flat-woven rugs, seldom well represented in Western museums, present a good study collection. The Daghestan embroideries and examples of broadcloth-mosaic, generally attributed to Resht, are again significant.

Today, the student of oriental carpets is faced with two larger problems: the question of origins, and the ethnographical aspects of more recent nomadic material.

The beginnings of rug weaving are hidden in the shadow of prehistory. The earliest evidence for the use of carpets is contained in the Pazyryk finds of Iron Age horsemen from the Altai mountains, dating from the 5th –4th centuries B.C. These finds show that all possible rug types were already known: felt, pile carpets, and flat weaves. Later discoveries only emphasized that these types have been produced side by side for millennia over a large geographical area, and that both the so-called Turkish and Persian knots must have been used for pile carpets from an early, as yet undetermined period.

While it is clear that the technology of rug knotting and weaving was already highly developed in the Iron Age, little is known about the variations of rug decoration and the geographical distribution of the motifs. The problem continues well into the Western Middle Ages. Only fragmentary conclusions can be drawn for the times before the 16th and 17th centuries, and there are a number of important areas, as for example Western Turkestan, from which material is unknown prior to the 19th century.

Under such circumstances, only hypothetical assumptions can be made about origins, and few sound hypotheses have as yet been put forward. Amongst these, the thoughts of Kurt Erdmann are the most interesting and convincing. (See K. Erdmann, *Oriental Carpets, an essay on their history*, New York: Universe Books, 1962, pp. 15 –16.) Concentrating exclusively on the evolution of pile carpets, he believed that the pile—formed by shorter and longer yarns, and knotted into the fabric during the weaving process—represents an imitation of animal skins. He interprets pile carpets as artificial pelts or skins, and connects their production to early herdsmen, the "shepherd-nomads" of the Eurasian steppes. He distinguishes them from the "hunting-nomads" of the lands lying farther to the north, who always had a good supply of furs, and who were able to make both garments and floor coverings from skins. To Erdmann's assumptions we may add that the mosaic-works in skin, still well known among the peoples of Siberia, might have influenced not only the knotting of pile into a woven textile, but the actual rug patterns as well.

Unfamiliar with ethnographical material, Erdmann was not aware of the importance of felt in the evolution of carpets. While pile fabrics might have evolved as an

imitation of the pelt (a development which rendered it unnecessary to kill an animal to obtain the raw material for fabric), the production of felt was another—probably even more archaic—innovation introduced by animal-keeping herdsmen from the steppes. Made mainly from wool with the application of pressure, moisture, and heat, not only is felt a fabric similar to skin, but it can be manufactured quickly without any particular equipment. It is consequently most suitable for the nomadic way of life. If felt rugs were found at Pazyryk, their origins must go back much farther in time. Mosaic work for felt rugs, and to a lesser extent applied decoration, provide further links to the ornaments of fur and skin: the motifs of felt rugs often stem from the same roots as those of pile carpets.

Flat-woven rugs must also be connected to similar traditions. Certain techniques, such as band weaves (used for carpets from Eastern Anatolia to Afghanistan), may have originated before looms were invented or in common use, but when certain simple equipment, such as cards, might have already been employed for the production of textile bands. Reminiscent of twining, *sumak* brocading is another "pre-loom" technique.

All these considerations suggest that oriental carpets originated in early prehistoric, probably Neolithic, times. The art of the oriental rug probably evolved from the nomadic life of the steppes, and for millennia the creations of herdsmen influenced the manufacture of similar textiles in the more settled surroundings of agricultural societies. Rug making, however, has remained a nomadic art form to the present day, if only because it has provided the herdsman's wool-based economy with an efficient, aesthetically pleasing means of storing his wealth. Thus the study of contemporary tribal material should not be considered solely as the realm of the social anthropologist, but also as a source for the understanding of a long-lasting tradition, which may help to fill many gaps in the historical and technological story of oriental rugs in general. It is still possible to carry out field research in this area, but the art is rapidly disappearing. Soon, even contemporary rugs will become part of history, as hard to interpret without first-hand experience or information as are the rugs of the past.

Caucasian carpet with overall sumak-brocading, wool warp and weft. 959 x 105.3

Left: The squirrelfish will make a sound if a diver touches its tail. The sound is a startlingly loud drumming and usually has the desired effect of momentarily frightening the diver—or the potential predator. (Caribbean Ocean)
Below: The cocoa damselfish is highly aggressive and has a repertoire that includes clicks, rattles, pops, and drumming sounds. (Caribbean Ocean)

Sounds from the Silent World

Eavesdropping on Some Fishy Conversations

A. R. Emery

Photographs by the author

"The silent world." In these simple, dramatic words Jacques-Yves Cousteau described his first wondering impressions as he began to explore the foreign and exotic undersea area of our planet. But he was wrong—wrong at least about the shallow, tropical coral reefs and Mediterranean grottos where he made these first explorations. The underwater world is one of beauty, grace, and savagery; but not silence.

Most of the sea is a vast, heavy, blue and black watery emptiness; an immense three-dimensional desert. A diver resting in open water, too far from the bottom to see it, and yet too deep to see the surface, is aware only of the cacophony of his own thoughts mixed with the brittle impressions of sound created by his inner ear in the absence of real sound. In this unnerving situation, the harsh, sudden, noisy rush of air gushing from an aqualung is very reassuring. All noises but his own disappear under the weight of the water which seems to press all sound away.

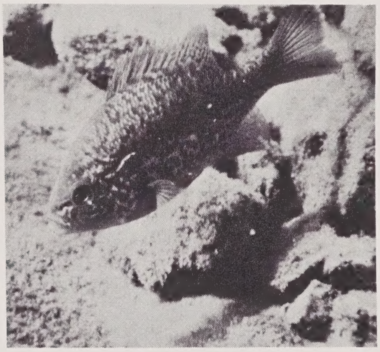
But on the shore waves crash, break over coral heads, and dash into the air over boulders. The thunder of the waves can be heard thousands of yards from the beach. We can easily hear the splash of a pebble thrown into water as we stand above it on a bridge. The random racket of rain creates a hissing sound on the surface of a pond. What happens to these sounds under water? Do the inertness and density of water blanket all sound, or is it only that we do not have the ears to hear?

Cousteau's underwater world was silent only because his human ear was not designed to operate efficiently in anything much heavier than the highly compressible and dynamic medium of air. In air, we perceive sound as a series of compression waves which force our highly flexible ear drums to move in synchrony with them. Displacement of air mass carries less than four inches and is not a significant part of hearing in air. The human ear drum cannot respond to sound frequencies below about 20 or 30 cycles per second (herz) nor to more than about 15,000 or 20,000 herz. Furthermore, the human ear is much more sensitive to frequencies near 1,000 herz than anywhere else. Thus a deep sound (50 herz) will sound fainter than a sound at 1,000 herz (about one octave above middle C), even if they are of equal energy content.

The underwater sound is carried by both compression waves and water displacement. Because water is not as compressible as air, sound can be transmitted by the actual movement of the water, as it cannot be by displacement of air, a far more compressible medium. Underwater sounds which carry short distances are called near-field, and result from the displacement of water mass. Those which carry long distances are called far-field sounds, and are primarily composed of compression waves, similar to the sound we hear in air. Far-field sounds carry so well under water that it is quite easy to transmit sound under water from Florida to Europe and Africa. In fact, the U.S. navy listens to propellers turning over 1,000 miles away. A diver listening very carefully can hear the far-field sounds produced by large fishes.

Fish have evolved to take advantage of both these types of sound. They use both an inner ear (which hears compression waves) and an outer "ear", the lateral line (which "hears" particle movement), for sound reception. This remarkable lateral line, which on most fish runs from just behind the head almost to the tail, is sensitive to "sound" far lower in frequency and far fainter than the human ear can detect. These sounds we might "feel" rather than hear. For this reason, the lateral line has also been called the organ of "distant touch", a sense we humans truly do not possess.

A fish swimming produces a "sound" which the lateral line of other fishes can "feel", if only because its tail or other fins produce vibrations. A predator crunching the shell of a crab, a nest-building



Above: A pumpkinseed sunfish hovering over the nest (the pale area beneath the fish), in an aggressive pose with the dorsal fin erect, and emitting clicking sounds. (Ontario freshwater)

Right: A rock bass fanning the eggs in his nest. Males guard the nests from potential predators with a series of gestures and poses accompanied by click and drumming sounds. (Ontario freshwater)

parent, and a jumping fish splashing back through the surface all make sounds. And yes, rain, waves, and a pebble thrown into the water make underwater sounds; sounds which are very different from those heard on the surface, but loud and distinct sounds just the same.

The underwater world is filled with the random sounds of moving creatures. But fish intentionally make sounds as well. Do these intentional sounds have any definite meaning? Are they the first evolutionary attempts in vertebrate animals to express a message in sound? Are these the precursors to our concept of language?

The earliest studies of fish sounds must have been carried out by fishermen using the wooden hulls of their fishing vessels, which functioned as resonating chambers and amplified the underwater calls of large fishes. But this peculiar knowledge extends no further than fishermen. Certainly I was unaware of it until I arrived in Costa Rica, equipped with electronic gadgetry, headphones, hydrophones, and tape recorders. Looking very modern and impressive, I asked the local Spanish-speaking fishermen to take me where there were many fish of the type called "croakers". No one could agree on such a location. When I lamely explained my intention to record their underwater sounds, instead of shaking their heads and looking at me as though I were daft, as I half-expected them to do, they reached instant accord on the best location. I immediately suspected a ruse. But once we were anchored over the spot with the engine off, the captain led me into the bilge. Placing his hands on my head, he pressed my ear to the thick wooden hull, and I discovered the "ancient" principle of listening to fishes. Later, when I played the sounds, vastly amplified by my tape recorder, the fishermen easily identified the fish or shrimp making the sound. These men were truly natural scientists, knowledgeable in a field that modern science is just beginning to explore.

Aristotle, that ancient master of fantastic encyclopaedic knowledge,

A sonogram is a graph comparing the pitch (highness or lowness) of the sound against the length of time it lasts. It is drawn mechanically by a highly technical machine from a tape recording. This sonogram depicts the croaking sound of the male splake, indicating his intention to attack another male.

Top: During courtship and spawning, the male splake crosses back and forth over the female and emits a very loud, deep roaring sound. (Ontario freshwater)
Above: The male pumpkinseed sunfish, when guarding its nest, will attack fish much larger than itself. By extending its fins it attempts to increase its apparent size and emits a sharp series of click sounds just before attacking. (Ontario freshwater)
Left: Pacific damselfish are among the many species whose sounds are not yet documented. Because of their affinities with the Atlantic forms, we can speculate that they have an extensive vocabulary. (Tropical Pacific Ocean)

knew of fish sounds. But only during the last World War did we recognize their widespread occurrence, when underwater sound detection was used to discover and document the travels of enemy submarines. The migrations of Atlantic coast fishes were so noisy that occasionally they completely blanketed the hydrophones. Since then, much effort has gone into designing hydrophones for the military that exclude fish sounds, and some money has been put into documenting fish sounds.

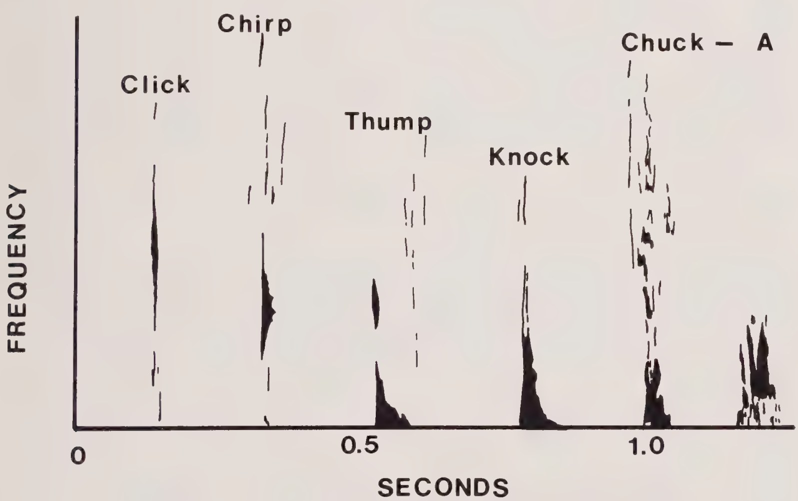
The earliest discoveries documented deep, booming calls from the swim bladders of marine croakers and catfishes. Immediately it was apparent that there were differences in the sounds they made: the call of a croaker could be distinguished from that of a catfish. This small distinction is of no little importance. It means that the catfish, in announcing himself as a catfish, has communicated an intelligible piece of information. That recorded sound, once it was deciphered, was the first evidence of a rudimentary "language".

Can we now look for more than just an announcement of identity? And how can we ascertain what intentional information is contained in the noises a fish makes? I have been attempting to translate the languages of fishes for five years. I have dealt with many species, and therefore with many languages. Hampered by the use of a hydrophone that, developed for other purposes, responds primarily to far-field sounds, I am surely missing a great deal of what the fish are "saying". Translation of the far-field fragments is difficult. But those fragments that I can record on tape are fascinating.

One of the most beautifully coloured and familiar of Ontario fishes is the pumpkinseed sunfish. The pumpkinseed is aggressive, cocky, and ebulliently garrulous. The male pumpkinseed guards his nest of eggs in the spring, threatening all comers with his brilliant colours, fierce stance, and aggressive noises. Prospective mates are courted with sounds, as well as with gestures and gentle touches. The sunfish vocabulary of far-field sounds is made up of two basic sounds—a high staccato and a low thump. The high staccato has two "word-forms": a "chirp" and a "click". The low thump has two "word-forms" as well, a "thump" and a slightly more distinct sound, a "knock". A fifth sound fits neither of these two categories; I call it the "chuck-a" sound.

As it happens, these same sounds can crudely be ascribed to dozens of other fish as well. To distinguish one fish language from another, we need to be able to describe each sound more accurately. The method I use displays the sounds as a graph, with the frequency (highness and lowness) of the sound plotted against time. Because the sounds last for only small fractions of a second, a machine called a sound spectrum analyzer is used to dissect the sound into a sonogram. The sonogram can be transformed into a symbolic representation of the sound by inking onto tracing paper only the outline of the fish sound. If this is repeated for many different recordings of the same sound, we can determine the correct "spelling" (omitting variations due to "dialects" or individual "accents") for each "word".

Each single "word" for any species can be illustrated and recognized as characteristic for the species. Sounds that to our ear seem the



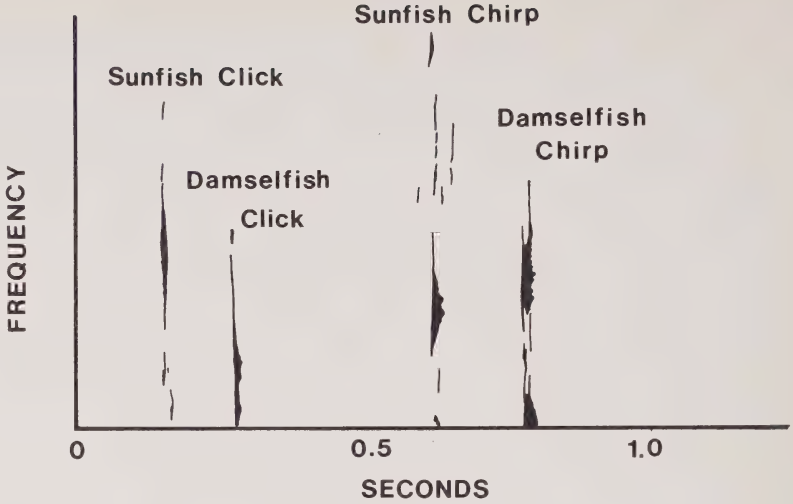
*A series of ink interpretations of sonograms details the "word-forms" in the repertoire of an Ontario sunfish, the pumpkinseed (*Lepomis gibbosus*). These can be combined by the fish into short "sentences" elaborating the meaning of the message.*

same are recognizably different on the sonogram. If we compare a freshwater pumpkinseed "click" to a tropical reef damselfish "click", we can see an obvious similarity, but they can also be distinguished from each other. The word "click" in sunfish language and in damselfish language is spelled a little differently (and pronounced a little differently), but is similar enough in each language to indicate a common origin. Both versions are probably produced by jarring the jaw teeth together in a scraping motion. And both have a common meaning. They imply an aggressive warning to an intruder. It happens that damselfish "click" is more specific than sunfish "click", and is directed only in a given context.

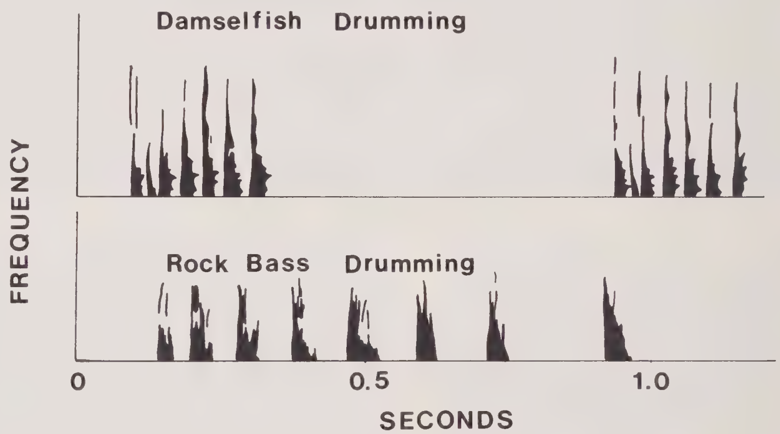
Single words can be elaborated into sentences, just as in human language. "Chirp" has a less intense meaning than "chirp-chirp". Furthermore, "chirp-thump" is a sentence used only when the intruder is quite close to the sunfish. Near-field effects are included in the "thump" sound, and this sentence also activates the lateral line of the intruder. Therefore, the defender is stating his views on intrusion through two hearing devices: the ear and the lateral line.

I have been able to detect many combinations of "words" for those species that have an extensive repertoire, but I have not always been able to translate these sentences. My first attempt at translation always begins with a look at the context in which the sound was produced. What was the situation? If that sound is produced in no other situation (a rare but welcome event), then I can easily speculate on its meaning. If a sound elicits a consistent response from another fish, I can be relatively sure of the meaning.

Last summer, I noticed a striking similarity between the sound produced by frightened rock bass and a sound I had heard in the ocean when large schooling fishes were suddenly startled into taking flight. Could there be a "universal" warning used by schooling fishes to indicate to other members of the school that a dangerous predator is ap-



Some fishes from very different areas of the world have quite similar "word-forms". The "click" and "chirp" of a tropical coral-reef damselfish and those of a northern freshwater sunfish are similar in meaning and sound, but can be distinguished as separate "languages" on the sonogram.



Both the damselfish and the rock bass produce drumming sounds using the swim bladder. These sound alike to the human ear, but they are in fact quite distinct and have different meanings. The drumming of the damselfish signifies a warning to a distant intruder, while the drumming of the rock bass indicates an intention to attack.

Fish often court their prospective mates with a combination of gestures, gentle touches, and exciting sounds. The hybrid trout called the splake produces a very deep rumbling sound, so deep that to represent it properly the scale has been altered to a logarithmic scale. The sound is produced by the male and triggers the female to release her eggs into the spawning gravel just as he releases milt, ensuring that the eggs are properly fertilized.

proaching suddenly? Or is the sound only an accidental one made when the fish dash away? I began to sort this out by feeding rock bass. I noticed that the sound was sometimes produced when two fish in the school rushed towards a single piece of food and were near collision. I then recorded the reaction to a shadow passed over the fish. A sudden thump was produced every time I tried it. But only fish in the school or near the shadow responded. Perhaps the sound had no meaning and the fish were only responding to the nearness of the shadow, even if it did not pass over them. But the next test was decisive. I played the sound back into the water just as the fish had produced it, but this time no shadow crossed over and no food was near. The school of rock bass resting quietly near the underwater speaker erupted into panicked flight. Other equally loud sounds, but of a staccato nature, produced only a mild reaction, often causing the fish to turn toward the underwater speaker.

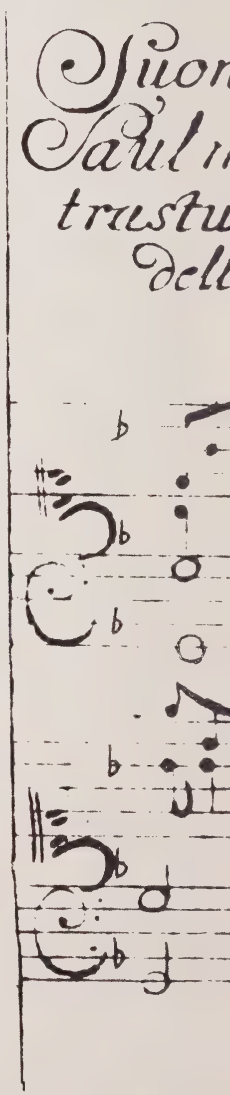
Another discovery I made during this experiment was that the fish responded to the sound only in the near-field range. This summer, I shall test this same sound on other schooling species to see if they too understand the "universal warning", a warning I have seen and heard operate in oceans and in fresh water, but which I have yet to test on different species in controlled conditions.

The study of sounds produced by fishes has already shed light on an area of profound ignorance in science. Its results could not only improve our understanding of the nature of communication among fishes, but might also help reveal the roots of our own human language. It also happens that this research will have several material benefits (a justification often wrong-headedly asked of basic science). Navies already use a knowledge of fish sounds to help them identify underwater sounds made by foreign vessels. Many giant industries utilize vast quantities of water, inadvertently sucking in and killing fishes and fouling the intakes. We might be able to combine the ecological advantage of saving these fishes with a solution to the industrial problem by means of a universal warning sound to deflect the fish. And perhaps fishermen could enhance their chances of success by using sound. Better still, we might be able to use sound to attract spawning aggregations to areas where the eggs could be protected artificially. Certainly all these developments are possibilities, but all depend on a firm knowledge and understanding of the languages of fishes, the meaning of the sounds from the silent world.

Dr. Alan R. Emery attended the University of Toronto, McGill University, Cornell University, and the Institute of Marine Sciences at University of Miami in studies for his Bachelor's, Master's and Ph.D. degrees. He has been leader or participant on expeditions to the Arctic, the West Indies, and the western Pacific and Atlantic oceans, where his work concentrated on undersea life. A comparison of biological observation in these highly diverse habitats in his opinion facilitates the separation of fundamental principles from the peculiarities associated with a single area.

The Melancholy Clavichord

A mere box of flies?



Ian R. Ball

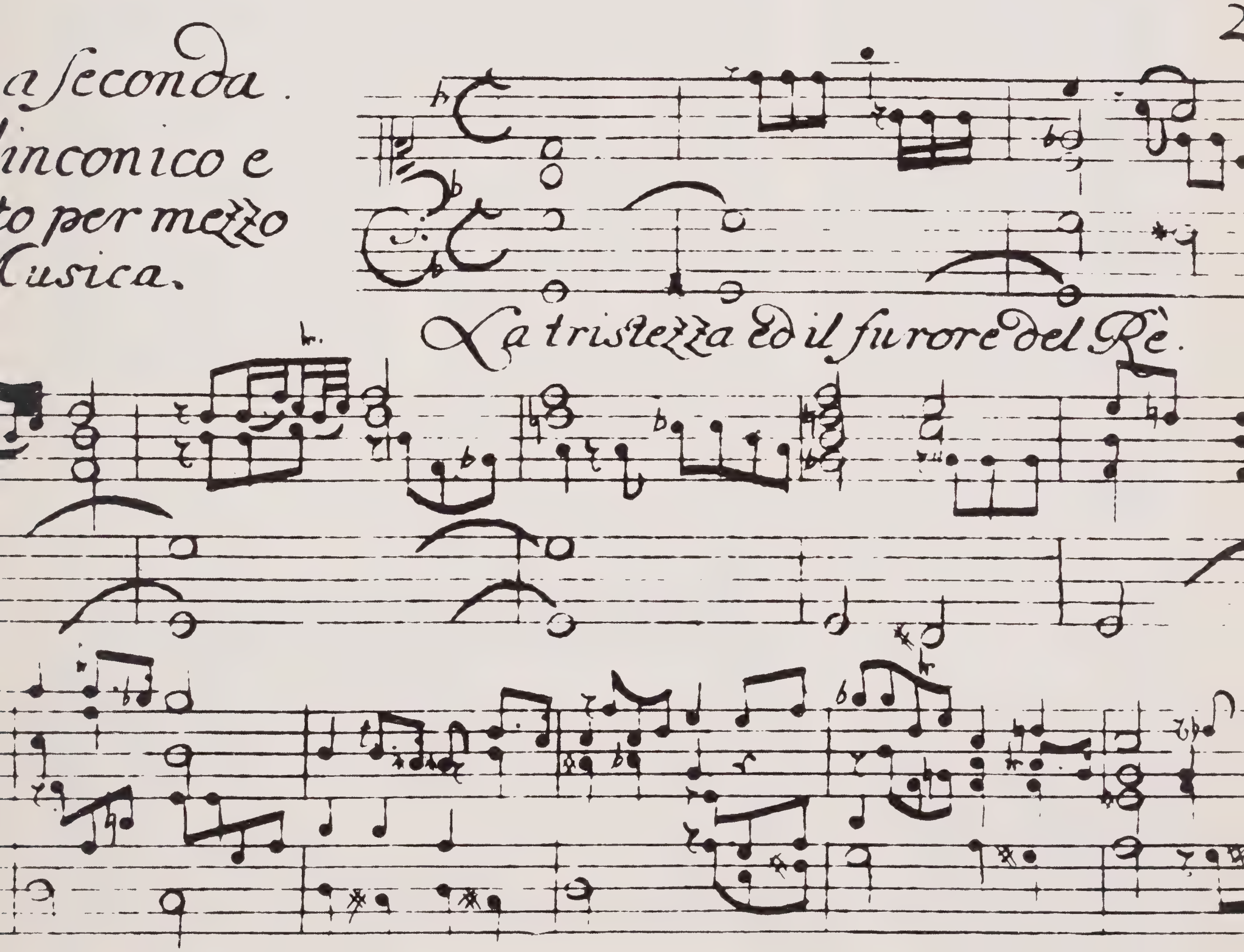
Artwork and Photographs
by Maria Tran Thi Vinh-Hao

Above: One of the earliest known representations of a clavichord. Detail drawn after a Flemish wood-carving of about 1450.

Right: Opening bars of Kuhnau's second Biblical Sonata for clavichord, "Saul cured through Music by David". Johann Kuhnau (1660-1722) was Bach's predecessor at Leipzig, and in 1700 he published his Biblical Sonatas, "in which I have tried to interpret some of the Biblical stories for the amateur performer".

"During this time he grew so animated and possessed .... his eyes were fixed, his underlip fell, and drops of effervescence distilled from his countenance." This description by Dr. Charles Burney could be of a man suffering from snake-bite or some dread tropical disease. But Dr. Burney was writing as a musician, not a physician, and the description is of a healthy and robust Karl Philipp Emmanuel Bach (1714-1788) playing upon his favourite instrument, the clavichord. The occasion was obviously a most singular one for the English traveller for he also tells us how, "in the pathetic and slow movements, whenever (Bach) had a long note to express, he absolutely contrived to produce, from his instrument, a cry of sorrow and complaint, such as can only be affected upon the clavichord, and perhaps by himself".

Dr. Burney's experience was by no means unique, for earlier the German composer and critic F. W. Marpurg had written, supposedly of the same player: "I know a great composer on whose face one can see depicted everything that his music expresses as he plays it at the clavichord". Clearly the third son of J. S. Bach was in the habit of following his own advice, which was that "A musician cannot move others unless he, too, is moved". And to move himself, and others, he chose the quietest and most introspective of all keyboard instruments, the humble clavichord. "Soul, expression, feeling, these things Bach gave first to the clavichord, and the harpsichord could not receive the smallest degree of them save from the hand of him who knew how to animate the clavichord" (J. F. Reichardt, 1752-1814).



The clavichord achieved the zenith of its popularity in mid- to late 18th-century Germany. At that time the instrument was little used in Italy and England, and the great French harpsichordists of the period, with their grand instruments by Blanchet and Taskin, dismissed the little clavichord contemptuously as a "mere box of flies".

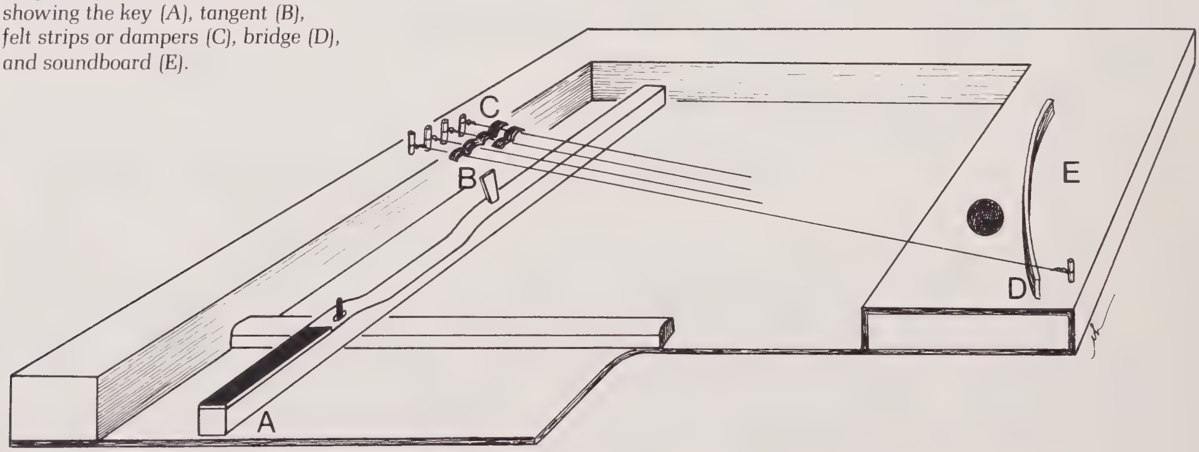
The modern city-dweller is assailed by noise of a variety that would have astonished 18th-century man. Traffic, television, muzak, and mechanization have imposed an almost intolerable pollutional load. Some seek relief in the monotony of amplified guitars and bestial drums; others escape to the quiet solitude of nature. My own affair with the clavichord began as an attempt to find quiet with nature, away from the pressures of modern life, through the most natural of arts, music. And what better instrument of communication than the clavichord, "that individual, melancholic, inexpressibly sweet instrument", an instrument for "those who do not like bluster, frenzy, and storm" (C. F. D. Schubart, 1739-1791). Today the clavichord, with its gentle and singing tone, is enjoying a revival paralleling that of the "amorous flute" (recorder) and "soft guitar".

The clavichord is the simplest, the loveliest, and the most difficult to play well of all the keyboard instruments. It has been said that a piece that takes two weeks to learn on the harpsichord may take seven weeks or more on the clavichord because of its expressiveness and sensitivity to touch. Basically, it consists of an oblong box 3 to 6 feet long, strung lengthwise. To the left the strings are damped with strips of felt. To the right the strings pass over a bridge, often elegantly curved, mounted on a soundboard which amplifies the vibrations of the strings. The strings are parallel to the keyboard, not perpendicular as in harpsichords and pianofortes. Towards the back of each key there is a blade or tangent (Latin, *tangere*, to touch), usually of brass. When the key is depressed the tangent rises and strikes the string, setting it in motion. But since the string is permanently damped to the left, only that part from the tangent to the bridge is capable of vibrating. Thus, not only does the tangent produce the note; it also determines its pitch by measuring the length of the string that will vibrate. And immediately the key is released the sound is arrested by the felt strips.

The simplicity of this action has important consequences for both the construction of clavichords and for the technique of playing them. Because the pitch of the note depends upon where the string is hit by the tangent, it is possible to construct clavichords with fewer strings than keys. When one string serves several keys, the instrument is referred to as being "fretted". Early clavichords were so built, and the reduction in the required number of strings made them small, light, and relatively portable. There is a serious disadvantage, however, in that certain chords are unplayable; when several tangents hit one string simultaneously only that nearest the bridge, which produces the highest note, will sound. So as music itself developed and became more complex, the instruments themselves had to evolve to keep pace with the new demands. Even so, fretted clavichords were still being built in the middle of the 18th century, such as the partially fretted instrument in the ROM's gallery. The oldest surviving unfretted clavichords date from the end of the 17th century.

From the viewpoint of tone production and technique the clavichord is unique among the stringed keyboard instruments. In the harpsichord, spinet, and virginals, the strings are plucked with plectra of quill or leather, and when the key is released a damper is placed against the string to quiet the note sounded. In the piano a felt-covered hammer is thrown at the string and then falls back. In the clavichord, however, the tangent strikes the string and remains in contact with it as long as the key is depressed. Thus, while the note is sounding the player is in

Diagram of the clavichord action showing the key (A), tangent (B), felt strips or dampers (C), bridge (D), and soundboard (E).



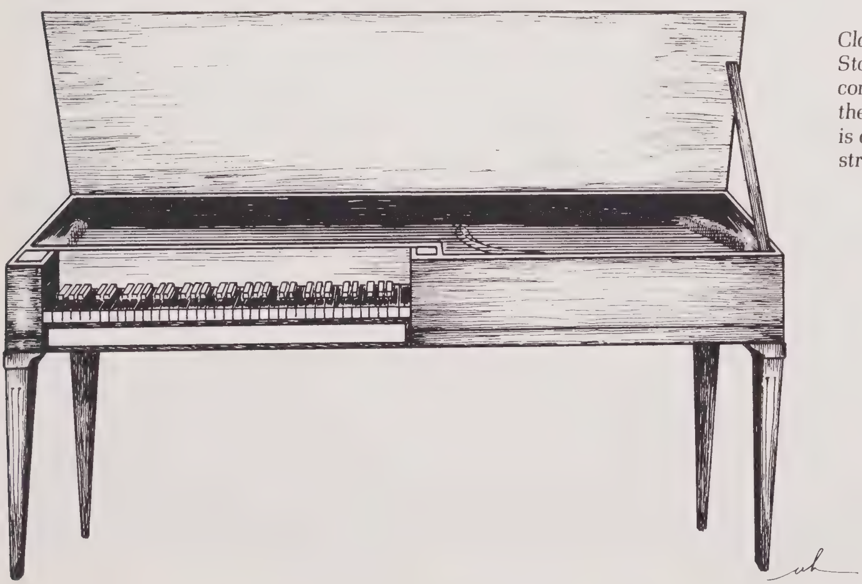
direct contact with the string by way of the tangent and the key, and by rocking the key with the finger a vibrato (*bebung*) can be produced. This is the basis of the "cry of sorrow and complaint" that so affected Dr. Burney, and only on the clavichord is it possible.

One of the earliest, if not the earliest, of all keyboard instruments, the clavichord is mentioned in a statute of the Augustinian choral foundation at Seckau of 1418. The earliest drawing is of about 1440, and a Flemish woodcarving of about 1450 shows, among other things, an angel playing a primitive clavichord. Its use in church is attested by a wood-carving of the first half of the 15th century in St. Mary's Church, Shrewsbury, and in 1477 William Horwood, Master of the Choristers of Lincoln Cathedral, was instructed to teach the boys the use of the "clavychord". The English version of the *Livre du Chevalier de la Tour Landry* (1371-1372), translated and published by William Caxton in 1484, contains the following interesting passage: "A yonge man cam to a feste, where were many lordes, ladyes and damoysels, and arrayed as they wold have sette them to dinner, and had on hem a coote hardye, after the manner of Almayne. He cam and salewed the lordes and ladys, and when he had done to them reverance, syre Geoffrey called hym before hym, and demanded hym where his vyell or clavycordes were, and that he should make his craft: and the yonge man ansuerd, Syre, I can not medle therewith. Haa, sayd the knyght, I can not beleve it; for ye be contrefaytted and clothed lyke a mynstrell."

The early forms of the clavichord were simple oblong boxes, with plain casework, that were placed upon a table for playing. As the music of the next two centuries developed so did the instruments. By the early 18th century they had a compass of about four and a half octaves, later achieving a compass of six octaves. The soundboard increased in size so much that in late examples it took about half the length of the instrument. To further increase the volume of their clavichords, makers often used double stringing, that is, two strings per note. In these cases, however, the intensity of the note was more likely to be affected by a slight inequality of the tuning of the two strings. On rare occasions triple stringing was also used. In the larger and more powerful instruments it was not uncommon for an additional set of octave strings, with their own bridge, to be added to enhance the timbre of the bass register.

As the mechanics of the instrument evolved, so did the cabinet work. From a simple, unadorned box, the clavichord developed into a piece of furniture of some pretensions. Turned, carved, or decorated legs were added, and the case was often lacquered with bright colours and the interior of the lid decorated with pastoral scenes, or even chinoiserie. In outward appearance the clavichord came to resemble the square piano that was to supplant it.

In the 16th and early 17th centuries composers were often unclear about the instruments for which their music was intended. One of the earliest composers to write specifically for the clavichord was J. J. Froberger (1616-1667). His music is both original and intensely beautiful, as can be heard in Thurston Dart's recording (SOL 60038). Froberger's introspective and melancholy frame of mind, so well suited to the clavichord, is reflected not only in his music, but also in the titles he gave to his pieces. The *Allemande* from his Suite XX is headed "Meditation on my future death: to be played slowly and freely". In his Suite XIV there is a "Lamentation on what was stolen from me: to be treated freely, and better than I was treated by the soldiers", and Froberger tells how in travelling from Brussels to Louvain he fell into the hands of a roving band of soldiers who robbed him, beat him up, and left him for dead. The piece was composed to comfort his bruised spirits; whatever else was bruised



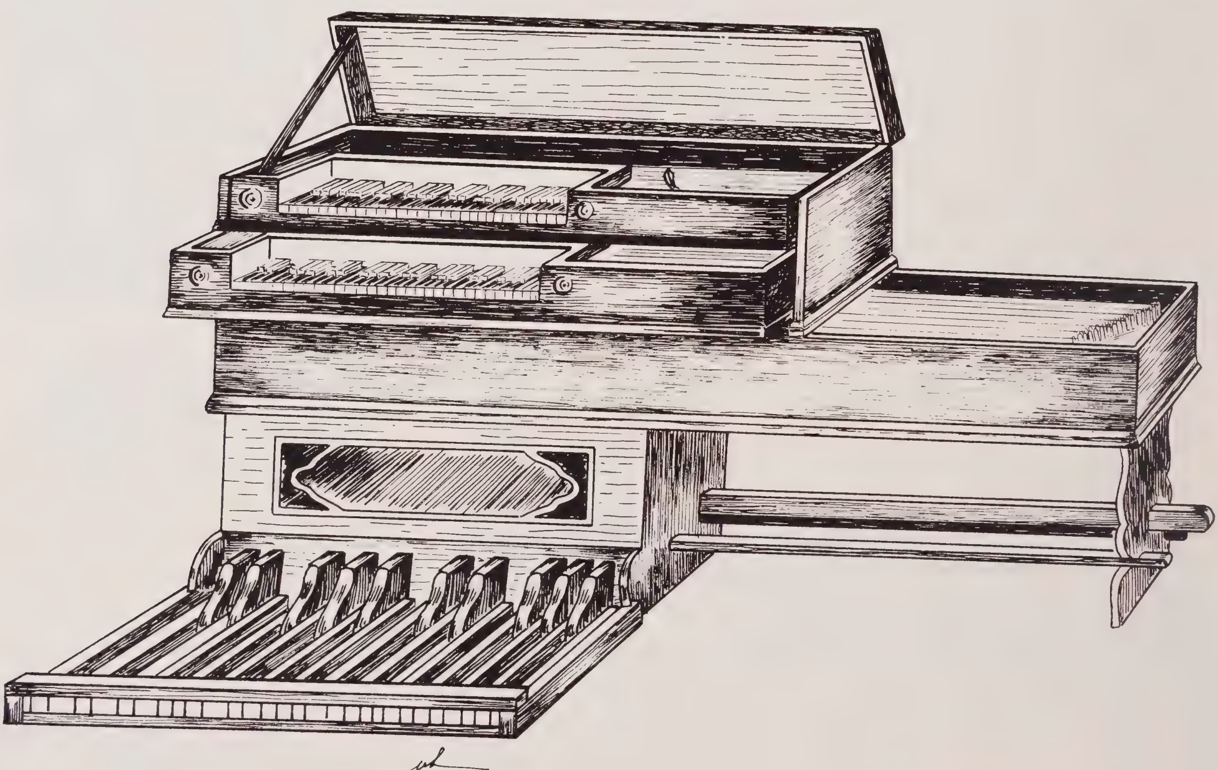
Clavichord by G.C. Rackwitz of Stockholm, 1796. Note the extended compass of five and a half octaves and the large soundboard. The instrument is double strung, with octave (4ft) strings as well for the bass register.

was no doubt beyond the therapeutic powers of music. The sad beauty and harmonic intricacy of Froberger's music are lost on the harpsichord, which is capable only of terraced dynamics. But on the clavichord, where the singing notes can be caressed, and the rise and fall of a phrase can be accentuated by touch, the music may be experienced in all its greatness. Johann Pachelbel (1653-1706) also took advantage of the soulful qualities of the clavichord. His *Musicalische Sterbensgedanken* (Musical Meditations on Death) were written for the instrument in 1683 during an epidemic at Erfurt which claimed both his wife and his son. Those who know Pachelbel's famous *Kanon*, a familiar signature tune on CBC, will need no convincing of the beauty and profundity of his music.

Both Froberger and Pachelbel influenced J. S. Bach, much of whose keyboard music was intended for the clavichord. J. N. Forkel (1749-1818), in his biography of Bach, tells us that "he liked best to play upon the clavichord; the harpsichord, though certainly susceptible of a very great variety of expression, had not enough soul for him; and the pianoforte was in his lifetime too much in its infancy and still much too coarse to satisfy him".

"Old" Bach's love of the instrument was passed to his son Philip Emmanuel, as we have seen. And from him we move to Haydn and Mozart. The early keyboard sonatas and divertimenti of Haydn are without doubt intended for the clavichord, an instrument that he played well. Because it is far richer in overtones than either the harpsichord or the piano, a Haydn sonata can be made to sound like a symphony in miniature when played on the clavichord. Mozart took with him on his travels "a nice little clavichord by Mr. Stein of Augsburg, which does us great service in allowing us to exercise our fingers on the journey". And much early Beethoven by no means comes amiss on a good clavichord, and may even have been composed at such an instrument.

As a practice instrument the clavichord is supreme. Partly this is due to its soft tone. In his *Musical Dictionary* of 1740 James Grassineau wrote: "The clavichord cannot be heard at any considerable distance; hence some call it the Dumb Spinet; whence it comes to be particularly used among the nuns, who learn to play, and are unwilling to disturb the dormitory". The boy Handel secretly practised the clavichord at night, so as not to disturb the household. Organists, too, found the instrument useful for practice and in the 18th century large double manual instruments with pedal-boards were built which allowed the organist to practise in the comfort of his home rather than in a cold and



Pedal clavichord by J. Gerstenberg of Saxony, 1760. Each of the manuals is double strung at normal (8ft) pitch. The pedal part has two 8ft and two 16ft strings for each note.

Left: The author playing a modern clavichord in teakwood made by Sigurd J. Sabathil.

Below: Clavichord from the ROM music gallery. Note the large soundboard and the angled keys. German, first half of 18th century.

draughty church.

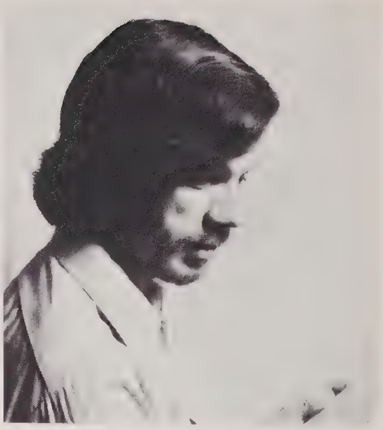
C. P. E. Bach believed it necessary to practise the clavichord to understand the full content of the music. "It is at the clavichord that a keyboard player may be most exactly evaluated. .... A good clavichord player makes an accomplished harpsichordist, but not the reverse." D. G. Turk (1756-1813) agreed with him and said that "one should not always practise on the harpsichord since this might cost one one's good touch. He who cannot have them both, should choose the clavichord".

This emphasis on touch indicates the real difficulties of playing the clavichord. Press the keys too hard and it is out of tune; too softly and no sound comes. A player who attempts to play too fast, and unevenly, produces nothing but a buzzing sound. It was probably for this reason that the instrument was dismissed as "nothing but a mere box of flies" by French harpsichordists of the Baroque era.

It is unfortunate that most modern makers have taken a miniaturist view of the instrument, stressing its quietness rather than its other qualities. Other instruments were quieter in the 18th century than now. A good Hass clavichord is very similar in tone to a Stein pianoforte of the period and perhaps only half as loud. Of course the vibrato, or *bebung*, is possible only on the clavichord. In an illuminating passage by Reichardt we find: "Herr E. Bach plays not only a very slow and songlike *Adagio* with the most touching expression .... he is also able to sustain in this slow tempo a tone of six quavers' duration with all degrees of power and softness; and this he can do in the bass as well as the treble. But he can accomplish it probably only on his precious Silbermann clavichord, for which he has also specially written some sonatas, in which he has introduced such long sustained tones. The same remark applies to the extraordinary power with which he renders some passages. Indeed it is the strongest fortissimo; and any other clavichords but Silbermann's would be knocked to pieces by it." Bach himself, in his famous *Essay on the True Art of Playing Keyboard Instruments* (1753), indicates that for accompanying a single voice or instrument "the clavichord and pianoforte enjoy great advantages over the harpsichord and organ because of the many ways in which their volume can be gradually changed". He would hardly have recommended an instrument that could not be heard.

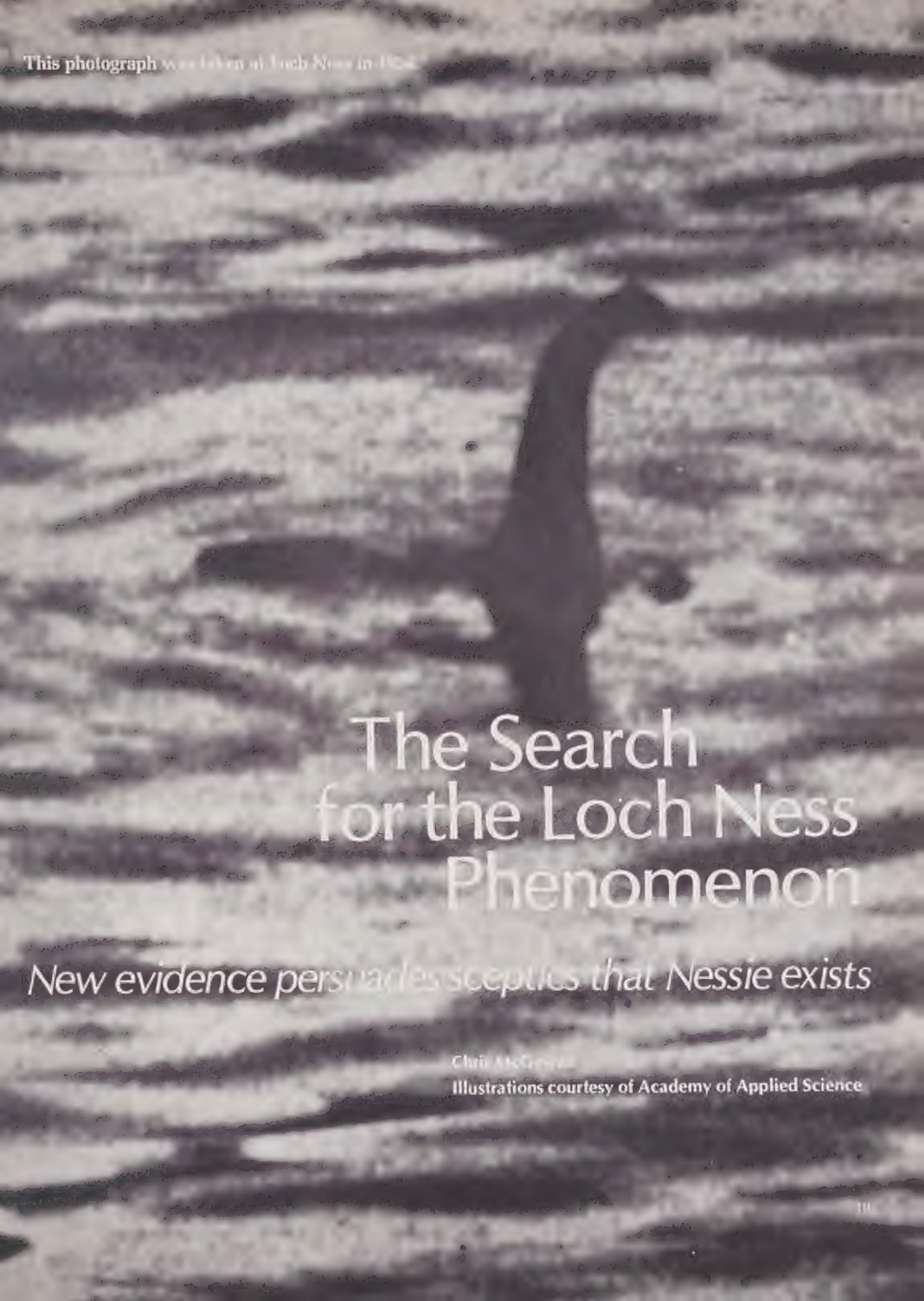
In England, Michael Thomas makes large clavichords, some of a pentagonal shape, that have this generous but introspective tone. His recording of music by Bach contains some of the loveliest and most sensuous sound on disc (Bach-Oryx 1231). A Canadian maker of clavichords, Sigurd J. Sabathil of Vancouver, has this to say: "The first quality I look for in an instrument is sweetness and fullness of sound. That does not mean that it has to be loud, this is not my aim, but I find that when I achieve a good quality of sound the instrument will also have a generous volume." My Sabathil clavichord, with a rich sound comparable to that of early fortepianos, is loud enough to support a recorder and softly played violin, and delicate enough to play late at night without waking my neighbours. The clavichord is indeed the perfect instrument for the modern city-dweller; a quiet refuge from the loud and fast pace of modern life. Nor need the modern clavichord player confine himself to old music. Several contemporary composers have written for the instrument, and many of the pieces from the first three books of Bela Bartok's *Mikrokosmos* sound surprisingly well on the clavichord. These are the works from which I began to learn the instrument.

The term "clavichord" is derived from the Latin *clavis*, key, and *chorda*, string. Jacob Adlung (1699-1762), however, has suggested a derivation from the Latin *cor*, heart, because "if the clavichord is of the right type and well played, it sounds quite as heart-rending, and far more sympathetic than most of the other keyboard instruments". Those who have discovered, as I have, the secrets of this simple box of wires will readily accept his explanation.



Ian R. Ball is an Assistant Curator in the Department of Entomology and Invertebrate Zoology, ROM. An account of some aspects of his scientific work appeared in the Fall 1974 issue of Rotunda. *His interest in music serves as a pleasant diversion from his scientific activities, though he much prefers playing his clavichord to writing about it.*

Maria Tran Thi Vinh-Hao, a native of Hanoi, is a Graphic Arts student at the George Brown College of Applied Arts and Technology. She also does some free-lance work as a scientific illustrator for the ROM and as an illustrator of children's books.

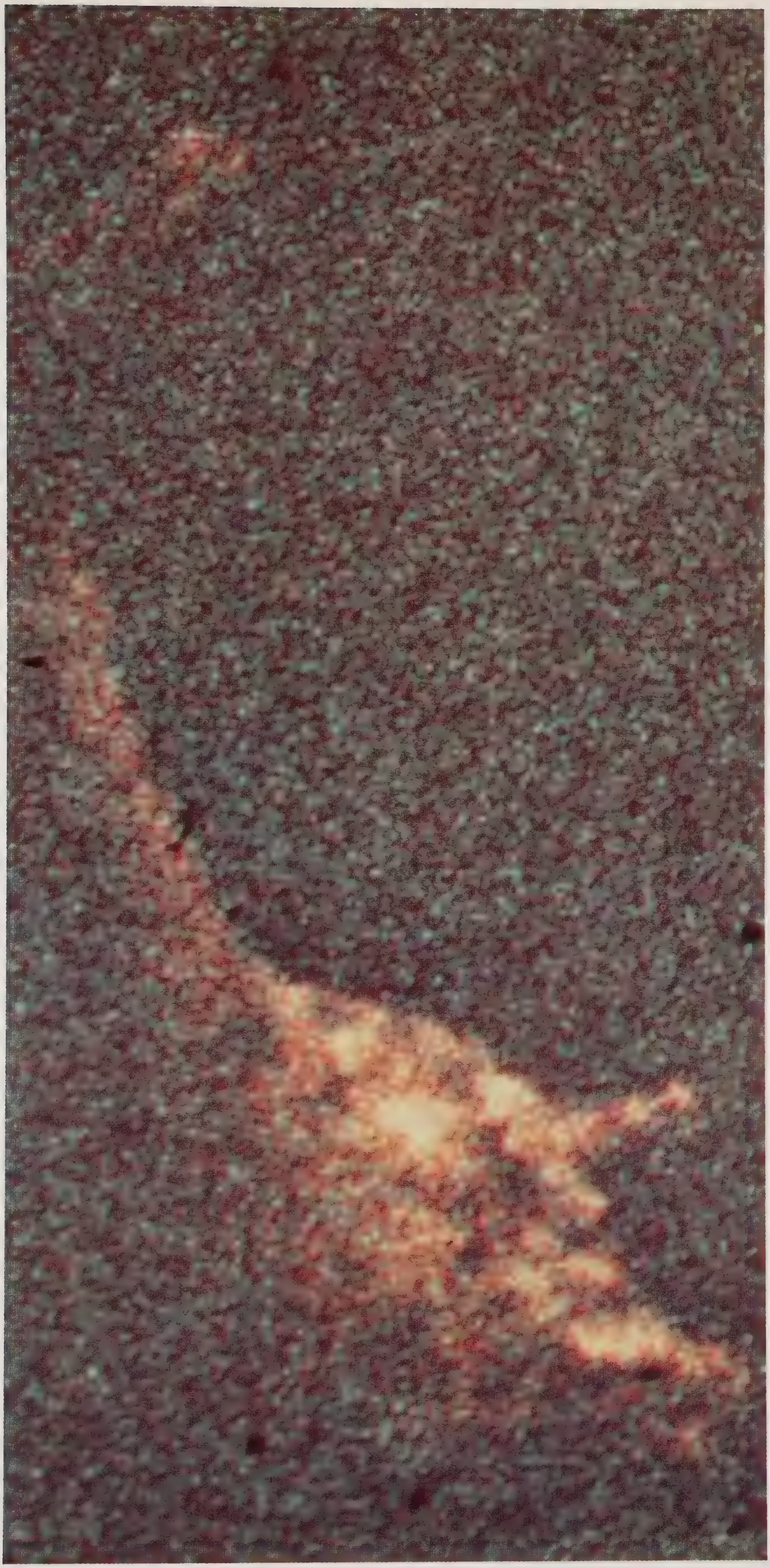


This photograph was taken at Loch Ness in 1934

The Search for the Loch Ness Phenomenon

New evidence persuades sceptics that Nessie exists

Chris McGowan
Illustrations courtesy of Academy of Applied Science



I do not miss many things about Britain, but I do miss the pubs. It is not just the quality of the beer, which must not be underestimated, but the convivial surroundings in which it can be enjoyed. Where else in the world could one find oneself in conversation with a complete stranger on the possibilities of monsters lurking in Loch Ness? Scotland is not at its best in December, and I was glad to get out of the wind which howls across the loch, and take a little sustenance. My new acquaintance was in no doubt whatsoever of the existence of "Nessie", and recalled in dispassionate terms what he had seen. He could have been describing his neighbour's sheep, or his new car; it was all very commonplace and quite unremarkable. That same evening I sat in another pub, and listened to another stranger telling me with equal dispassion that it was all a bit of a joke, and that there was nothing peculiar about Loch Ness, apart from the visitors who came each year to see a monster. The believers are outnumbered by the disbelievers, but some of the latter are converted late in life.

My host's neighbour had been a disbeliever. His house overlooks the loch and he enjoys a fine view from his garden. If there was something in the loch, he used to argue, then surely he would have seen it after all these years. He does not hold this view any more because, quite recently, he saw something in the loch which completely changed his mind. My own few days at Loch Ness were soon over, and I was left in a state of some confusion. I could barely comprehend that I was involved in this fantastic affair, much less decide whether or not I believed in a Loch Ness being.

My involvement began last October when Sir Peter Scott, an eminent British naturalist and Chairman of the World Wildlife Fund, visited the ROM. Sir Peter showed me some underwater photographs taken during the summers of 1972 and 1975 by Robert Rines, a physics graduate of M.I.T. who is now a successful patent lawyer in Boston. Until that time I had never given serious consideration to the Loch

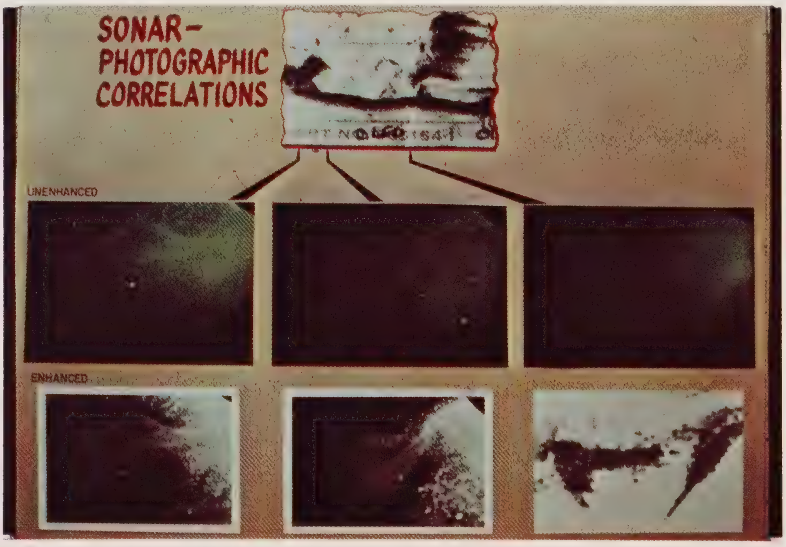
Ness phenomenon, but the evidence set before me was compelling. A few days after seeing the photographs I received a request from Rines to submit a written opinion. A number of other scientists were shown the evidence and invited to submit opinions, and they, like me, were asked to do this in the strictest confidence. Before very long I received an invitation from the Royal Society of Edinburgh to attend a symposium that was to consider all the evidence. The meeting was to be held in the Scottish capital, and, to prevent a public debate in the press before the event, the participants were asked to remain silent. Unfortunately this was not to be so. The story leaked to the press, and the resulting furor caused the Royal Society of Edinburgh to cancel the meeting in the belief that "no useful or impartial discussion can take place at this time under these circumstances". Alternative arrangements were hurriedly made for a London meeting, but the press was not to know of this. I left Toronto in early December as originally planned and travelled to Scotland, spending a few days at Loch Ness before going to London.

Loch Ness is the largest of three lochs that lie in the Great Glen Fault, a huge gash that runs diagonally across the Highlands in a northeast-southwest direction. In recent times the three lochs have been connected by canals, forming the Caledonian canal system which provides a throughway for small vessels, mainly fishing boats, between the Atlantic Ocean in the west and the North Sea in the east. There is no commercial fishery on Loch Ness itself. Changes in water levels between Lochs Ness, Lochy, and Oich necessitate a series of lock gates at intervals along the canals. To the north, Loch Ness drains into the River Ness, which in turn flows into the sea at Inverness. Although Loch Ness has indirect connections to the sea at either end, clearly there is no access for the passage of large aquatic animals.

Loch Ness is about 25 miles long, a mile wide, and at least 700 feet at its deepest point, comparable in this respect with the Great Lakes. Unlike our lakes, the water is very deep close to shore; one has only to go a few yards to be out of depth, and the water is soon more than 100 feet deep. The Great Glen is V-shaped in section, the sides of the lochs are steeply shelving, and there is but a narrow beach. Rising above the loch to heights of 1,000 feet on either side are heather-clad slopes of sandstone. Several rivers drain into the loch, carrying with them quantities of peat that discolour the water and add much particulate matter. The prevailing winds are from the west, and there is invariably a substantial wave action, which at times can be very rough and dangerous for small vessels. Because of the influence of the North Atlantic Drift, the northern extension of the warm Gulf Stream, the winds are warm and have an ameliorating effect on the climate. The loch remains ice-free throughout the year.

The legend of Loch Ness dates back to the 6th century, when it is said that St. Columba, the Abbot of Iona, had an encounter with a large aquatic animal during a visit to the area. There have been numerous and varied accounts since, but not until the early part of the present century did reports become frequent. The reason, no doubt, lies with the construction of the coast road in the early thirties, a road which runs the length of the north shore of the loch. As the automobile became available to more and more people, and as holiday-makers travelled farther afield, sightings became more frequent. Photographs also began to appear, and one of the most famous is that taken in 1934 by Mr. Kenneth Wilson, a London surgeon on holiday. Early one morning, as he was driving along the north shore on his way to Inverness, something in the loch caught his attention. He stopped his car to investigate, and saw what he described as a head breaking the surface. He returned to his car for his camera and, using a telephoto lens at a range of two or three hun-

Opposite page: Underwater photograph taken at 4:32 a.m., June 20, 1975, of what appears to be a small head (at top left) connected by a long, thin neck to a globular body (at bottom right), which has appendages projecting from it. Total length of the object is about 20 feet. (Academy of Applied Science)



Right: Underwater photographs taken in 1972, correlated with the sonar chart taken simultaneously. The upper, green-coloured frames are from the original 16 mm film. The lower three frames are the same pictures after they have been computer-enhanced. The two sets at the left are flippers, while the set at the right is believed to show the region of overlap between the two bodies. (Academy of Applied Science)

dred yards, he took the photograph shown on page 19. I have read a published evaluation of this photograph and there are no reasons to doubt its authenticity. There have been many other photographs since 1934, some of which I have seen, and they vary from exceedingly poor fakes to very convincing evidence.

One of the main contributions of the Loch Ness Investigation Bureau, which was founded some 15 years ago by a group of interested people, has been to collect and verify sightings. The Bureau has more than 200 verified sightings on file, that is, sightings made by more than one person or sightings accompanied by photographic evidence. Not all sightings are made by summer visitors, of course, and among some of the interesting local sightings are those of Alex Campbell, who was water bailiff in the area for 40 years. He described watching a large animal floating on the surface, with a long neck held high above the water. On another occasion he saw two individuals, one of which clearly possessed paired flippers.

In Britain I met five people, each of whom had had independent sightings. I was impressed by their sincerity and by what they had to say. Of particular significance is the similarity of so many of the observations. Time and again there are reports of large V-wakes moving across the water when there are no surface vessels in the vicinity. Sometimes the cause of the disturbance is seen, and it is invariably described as a hump. Very occasionally there are more detailed descriptions, with frequent reference to a long neck and small head. Many reports, of course, are fanciful and may be dismissed, but there remains a very substantial body of evidence.

Map by Julian Mulock

In August 1968, the Department of Electronic and Electrical Engineering of Birmingham University, England, carried out some trials of a new type of sonar equipment in Loch Ness. Most of the time nothing particularly interesting was recorded, but there was a period of about 13 minutes when something unusual occurred. The results were reported by H. Braithwaite and D. G. Tucker in the *New Scientist* (Vol. 40, No. 628). Large moving objects were recorded travelling at speeds of up to 15 knots and diving at the rate of up to 450 feet per minute. The length of the objects was in the order of several yards, and it was concluded that they were unlikely to be fish. The authors were tempted to suggest they were "Loch Ness monsters", but concluded that although this was possible, the present data were quite inadequate to support such speculation.

Two years later Martin Klein, a sonar specialist who heads an underwater search and survey company in New Hampshire, and Robert Rines, president of the Boston Academy of Applied Science, visited Loch Ness to conduct further sonar experiments. They too obtained contacts with large moving objects that confirmed the observations of Braithwaite and Tucker. Rines returned the following summer and carried out preliminary experiments with an underwater camera. The photographic equipment was designed and developed by Professor Harold Egerton of M.I.T., pioneer of synchronized strobe-light photography. By the summer of 1972 the equipment was ready for operational use. Accompanied by members of the Boston Academy of Applied Science and assisted by the Loch Ness Investigation Bureau, Rines set up the equipment on two vessels in Urquhart Bay. One vessel carried the photographic equipment, which was lowered to a depth of 45 feet; the other carried the sonar transducer, which was aimed towards the camera. The camera and synchronized flash were set to fire off automatically at 45-second intervals; the sonar was recording continuously. On the night of August 7 the two vessels took up their stations, and the crews waited. Rines reports that it was very calm and uneventful until 1:40 a.m., when he became aware of fishes leaping out of the water. At this point the crew on the sonar vessel shouted across that they had made a contact with a large moving object. Soon a second moving object appeared on the chart, and for a brief interval they appeared together in front of the sonar transducer. The crews hoped these objects would be captured by the camera, but, as the field of vision of the camera and its depth of focus were limited, this did not necessarily follow. On their return to the U.S. the Boston team had the film developed and sent copies of the sonar chart to a number of independent sonar specialists for interpretation. The specialists all agreed that the objects were large, 20 or 30 feet long, and moving, and it was further pointed out that one of the objects extended what appeared to be an appendage, which may have been 10 feet long. The photographs were initially rather disappointing; only two frames were of interest, and the quality was poor.

The primary reason for the poor photographic results was the scattering of light by the peat particles in the water, which made the photographic images hazy and indistinct. Much of this "noise" was subsequently filtered out using the process described as computer enhancement. This technique is widely used in applied science, especially astronomy; it increases the image contrast and filters out much of the background noise. The process cannot add to a photograph anything that is not already there, and it cannot alter the image. An analogy is the treble control on a record player; turning down the control filters out the high frequencies but does not alter the music. Each of the enhanced frames

clearly shows a flipper-like structure which can also be seen in the unenhanced photographs once one knows what to look for (see p. 21).

Optical estimates for the size of this structure are readily deduced. Parts of the structure are in focus, and to be in focus, the object has to be at a given distance in front of the camera because of the fixed focal length of the lens. Once the range has been established, which can be confirmed by densitometric measurements, the size of the objects can be deduced from the size of the image. Of considerable significance is the fact that the optical estimate compares with the independent sonar estimate: the length of the flipper is estimated to be between 6 and 8 feet. There was much discussion at the London meeting on the size estimates, and Egerton was adamant that the flipper could not have been less than 4 feet long. I am particularly impressed by the flipper photographs because they show those attributes of a control surface (e.g., long trailing edge, short leading edge) that I would expect to find in an aquatic animal.

Improvements were made in the equipment and the group returned to Loch Ness in the early summer of 1975. This time two cameras were used. The main camera was lowered to a ridge on the bottom and was linked to a sonar apparatus, set to trigger off the camera if a large moving object came into the area. The second camera, used as a back-up, was suspended from an anchored boat and set to fire off automatically at about one-minute intervals. But the back-up camera was the only one to take any pictures; it was later discovered that the main camera had sunk in the silt and was therefore rendered inoperable. At 4:32 a.m. on June 20, 1975, at a range of about 25 feet and at a depth of 35 feet, contact was made with a large moving object, later estimated to be 20-25 feet long. The structure at the top left of the photograph on page 20 is interpreted as a head that is joined to a globular body by a long, thin neck. The neck region beneath the head is in shadow so that the head appears to be disconnected from the neck. Appendages can be discerned projecting from the body. Adjacent frames, taken one minute before and one minute after, show nothing. Nothing more is seen until 11:45 a.m. when, at a range of only 4 or 5 feet, and still at the same depth, an interesting frame is exposed in the middle of the series shown on page 24. At the top of the sequence nothing is to be seen; then a photograph of the surface with a silhouette of the boat appears. In the next frame is an image that has been interpreted as a head. The field of the camera then returns to the surface and several frames pass before there is a return to the blank frames that started the sequence. Apparently something has set the camera into violent oscillation, causing it to swing up and down and point towards the surface several times before settling down.

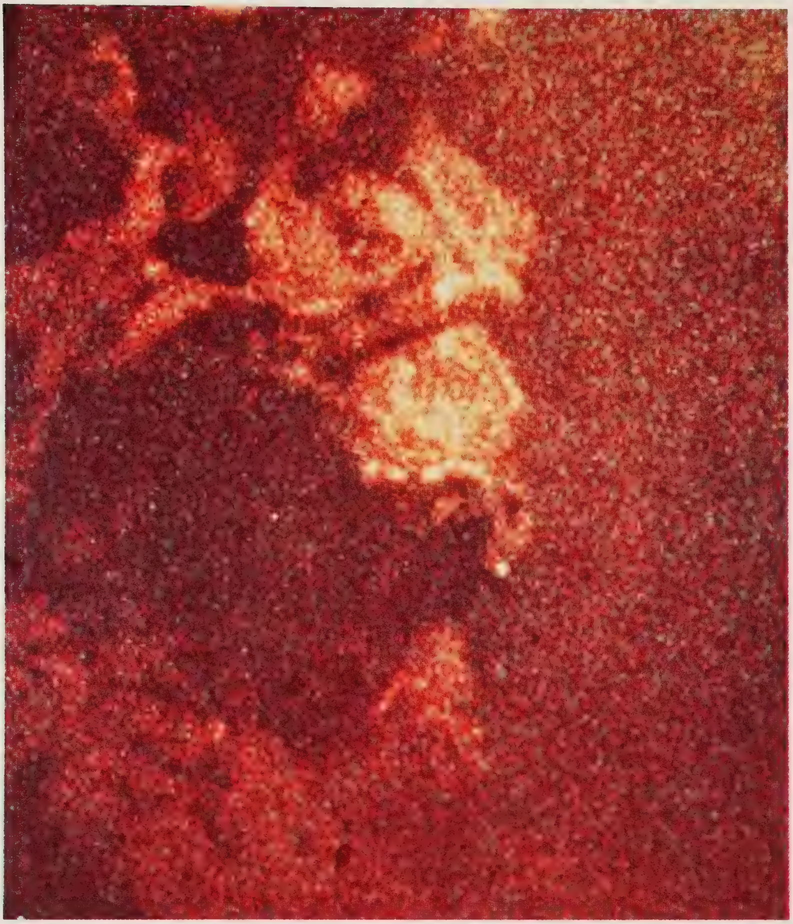
An enlargement of the frame with the head, which has become aptly known as the gargoyle, is shown on page 24. Several zoologists, including Dr. George Zug of the Smithsonian Institution, have studied this photograph and are able to see bilateral symmetry, which suggests that it is a head. An eye can be seen, and also a muzzle which appears to have a raised ridge. I have never been very impressed with this picture and think it is possible to make many interpretations.

When I arrived in London I spent three days with Rines and his colleagues; I had many questions, but I also wanted to become acquainted with the man. We also met with other specialists at the British Museum (Natural History), and most were as interested in Loch Ness as I was. These three days of discussions led me to a number of conclusions. I was satisfied with the integrity of the Boston investigators, and with the authenticity of their data, and felt that there was sufficient evidence to support the existence of an unexplained phenomenon of considerable interest in Loch Ness. The evidence suggested the presence of large aquatic animals.

According to the original plan the Edinburgh symposium was to be followed by a presentation of the evidence at the British House of

Part of the sonar chart recorded on the night of August 7, 1972. The long dark objects represent two large moving objects. An appendage can be seen extending from the lowermost object. The shape of these traces does not represent the actual shape of the objects, but is a function of their length and speed and the speed of the paper. (Academy of Applied Science)

Right: Sequence of underwater photography exposed at 11:45 a.m. on June 20, 1975. The first frame shows the camera boat, silhouetted against daylight as the camera points up to the surface. The second frame shows a pool of light at the surface as the camera still points upwards. The third frame reveals a structure which has been interpreted as a head; in subsequent frames the camera again points to the surface. Below: An enlargement of the "head" frame. Some zoologists are able to detect an eye and a muzzle with a raised ridge. There is a suggestion of horns on the top of the head. (Academy of Applied Science)



Commons. When the Edinburgh symposium was cancelled, the meeting in the House of Commons became a logical substitute. The presentation in the House of Commons was made by Rines and a number of other invited speakers and was well received by an audience of scientists, journalists, and other interested people who sat for three hours to consider the evidence. In addition to seeing the latest photographic and sonar evidence they heard several eye-witness accounts, including one by Tim Dinsdale, an aeronautics engineer who is now a full-time investigator of Loch Ness. Dinsdale illustrated his account with a film that showed a hump moving across the loch which left a considerable wake. The location could be identified by landmarks as Loch Ness, and the north road with cars going past could be identified in the background. At one point a seagull conveniently flew across the frame, adding further evidence to the authenticity of the film. When the hump disappeared from view, Dinsdale arranged for a local fisherman to take a power boat of known size (14 feet) along a similar course, and the boat was filmed from the same spot. When the two film sequences are compared one sees that the wake left by the first object is considerably larger, and the fact that it clearly lacks a screw-wash rules out the possibility that it was formed by a boat. The film has been analyzed by staff of the Joint Air Reconnaissance Intelligence Centre, England, who concluded that the object was not a surface boat, nor a submarine, but was probably an animate object. They estimated its length at 12 to 16 feet and its speed at 7 to 10 m.p.h.

The general feeling of the scientists present at the meeting could be judged from the questions they

asked. The majority thought the phenomenon of considerable interest, and worthy of further investigation. For the first time, it seemed, the Loch Ness phenomenon had gained scientific respectability.

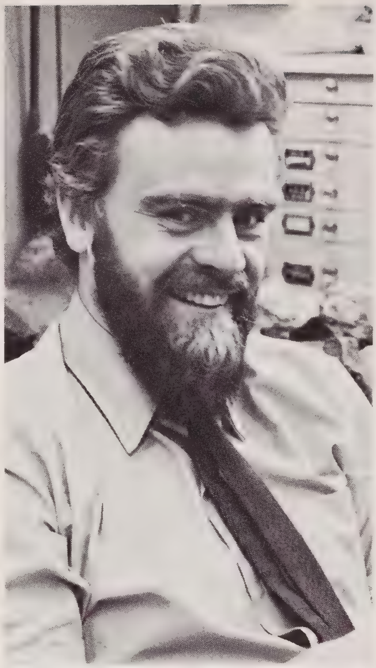
However incredible the discovery of large unidentified animals may be, it is not without precedents. In 1938 a large fish was caught in a trawl off the coast of South Africa and was subsequently identified as a coelacanth (*Latimeria chalumnae*). Coelacanths are well known in the fossil record, but they were thought to have disappeared at the end of the Cretaceous Period (about 65 million years ago) and were therefore believed to be extinct. The announcement of the discovery by Dr. L. B. Smith, who described the specimen, was received with considerable scepticism by other biologists, but the facts were undeniable. The selection of this particular example should not be taken to imply that I believe Loch Ness to house a group of survivors from the past; this has become a popular notion, but is without foundation. Descriptions of the Loch Ness animal frequently refer to a long neck, small head, and flippers, features which are consistent with our knowledge of plesiosaurs (a group of swimming reptiles that became extinct at the end of the Cretaceous). But it would be wild speculation to suggest that there are plesiosaurs in Loch Ness.

It would be equally rash to make any attempt at identification; we simply do not have enough information. I used the example of the coelacanth, but I could have chosen the okapi (*Okapia johnstoni*), a relative of the giraffe which was unknown to the scientific world until it was discovered in 1900 in the Congo, now Zaire, or the Mountain Gorilla (*Gorilla gorilla*), discovered the following year on the borders of Zaire.

I could also have chosen the discovery of Piltdown Man. In 1912 the discovery was announced of a skull of a very primitive man, heralded as being the much-sought "missing link" between man and the apes. The specimen was studied and discussed for the next 30 years, but in 1953 it was found to be a complete fabrication.

Perhaps it is the memory of the Piltdown hoax that causes some people to be sceptical of the Loch Ness phenomenon. There have certainly been many hoaxes perpetrated at the loch over the years, but we should not let these influence our judgment of the other evidence. Probably the main reason why some people cannot accept the existence of large animals in Loch Ness is the problem of how they came to be there. Until about 12,000 years ago most of Scotland, including Loch Ness, lay under a great thickness of ice, and it is inconceivable that anything could have lived there. The inhabitants of the loch are therefore relatively recent arrivals. Where did they come from? Why and how was Loch Ness colonized? I cannot begin to answer these questions, and feel that they are not even appropriate at this point. We have before us evidence that supports the existence of large, unidentified animals in Loch Ness, and the first task is to identify them. Only then can we attempt to answer the other questions.

I know of many people who would prefer the phenomenon to remain a mystery. I can sympathize with this wish, though I myself want to find out much more. But I do not want to do so to the risk of any animals living there, or of their environment. I feel most strongly on this point. It was with conservation in mind that Sir Peter Scott and Robert Rines gave the Loch Ness animal a scientific name, *Nessiteras rhombopteryx* (*Nature*, Dec. 11, 1975, Vol. 258). Most zoologists thought that it was imprudent to erect a formal name before any animal was found, but as the authors explained in the *Nature* article, animals cannot be given full protection in Britain unless they have a scientific name. Conservation must come before all other considerations, especially at Loch Ness where there is likely to be only a small population, and where the loss of even a single individual could trigger their extinction.



Dr. Chris McGowan is Associate Curator-in-charge of the Department of Vertebrate Palaeontology. He was born in England and spent his undergraduate and graduate years at the University of London. He joined the ROM in 1969, where he specializes in the study of ichthyosaurs. Since his visit to Loch Ness he has lectured extensively on the phenomenon.

The author wishes to thank Robert Rines for giving him permission to publish his photographs, and for making information freely available to him. He also wishes to acknowledge Tim Dinsdale, author of a series of excellent books on the Loch Ness phenomenon, from which he has drawn much of his information.

The Growing Collections

The lacquered penbox (*qalamdan*), recently acquired by the West Asian Department, is characteristic of Persian art of the 19th century produced during the Qajar Dynasty. During this period traditional Persian styles and motifs were readily mixed with European influences. Here, in the central oblong medallion, a seated youth plucking a rose from a basket is painted in an "Italianate" style. The fashions of the women shown in the other compartments belong to the European world as well. The military dress of the male figures helps to date the pencase to the second half of the 19th century.

L.G.

Above: Two pages from the Wonders of Creation.

Left: Lacquered penbox from the Qajar Dynasty, Persia.

The West Asian Department is pleased to have acquired a profusely illustrated copy (409 miniatures) of the *Wonders of Creation*, by Qazvini. Throughout the mediaeval Islamic world treatises of this type appealed to the average reader's curiosity about the natural and supernatural worlds. Two pages from this "encyclopedia" show the Archangel Michael and the Angel of Death, as he appeared with a "horrible face" to Solomon. This copy was completed in 1673 by a scribe from Multan in northwestern India, which came under strong Persian influence.

L.G.

The Far Eastern Department's first purchase acquisition of 1976 is the Myōken Mandara, a Japanese Buddhist painting of the late 16th or early 17th century. The *mandara* is a hanging scroll painted in ink and heavy colour on silk, with very well-preserved cut gold. The painting proper measures 116.6 x 49.9 cm. It dates from the last great period of Buddhist art in Japan, and balances well with the ROM's Taima Mandara (13th c.) from the first great period.

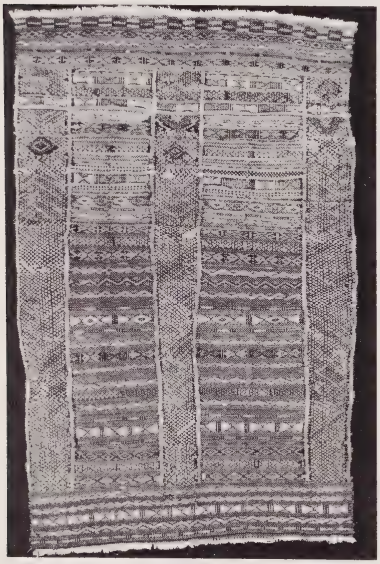
The *mandara* presents a fusion of Taoistic elements with native Japanese Shintō and esoteric Buddhism. Belief in the bodhisattva Myoken came to Japan from Korea during the Heian period (9th c.) and had strong astrological connections. The Myōken festival was celebrated with the lighting of lamps and an invocation to "uphold the rulers, to rectify the cosmic patterns, to preside over the cycles of creation and destruction, to brighten the darkness and to illuminate man's good and evil". Myōken's home was in the constellation Ursa Major, depicted in the centre of the painting. A circle of light encloses the bodhisattva whose left hand holds a lotus and whose right hand is in *varada mudra*. Above are the circles enclosing the figures personifying the seven stars of Ursa Major. At the top is the bodhisattva in the so-called "outer court" represented as four-armed and holding what appear to be *yin* and *yang* symbols of unusual type: the left hand holds a seal with a swastika and the right holds what appears to be a key.

The Myōken Mandara is an important addition to the ROM's collections, a work of rare subject matter which has already excited much interest from scholars of Japanese painting.

T.Q.

The Myōken Mandara.

Berber rug, Morocco.



Miniature portrait identified as William III from snuff box.

This Berber rug from Morocco is the first example of North African weaving among the small but comprehensive collection of flat-woven carpets in the Royal Ontario Museum. Although flat-woven rugs are important both historically and artistically, they have been the object of all too little scholarly attention. Not much is known about their origins, tribal divisions, and the geographical distribution of the different types. The 1969 exhibition "From the Bosporus to Samarkand", organized by the Textile Museum of Washington, D.C., might have been their first real recognition in North America. In 1976, the Textile Department of this Museum will organize a smaller show of oriental rugs in the textile galleries, in which emphasis will be placed on flat-woven examples. A catalogue of this material is also planned.

V.G.

Aeschnogomphus intermedius *(dragonfly), Upper Jurassic, Eichstatt, Germany.*

The Department of Invertebrate Palaeontology has recently purchased twelve fossils of Upper Jurassic age from the region of Solnhofen and Eichstätt, Germany. The lithographic limestone from this area is famous for its fossils, many of which show preserved details of soft body tissues. The new collection includes the impression and cast of a large dragonfly, *Aeschnogomphus intermedius* (Hagen), with a 7½-inch wing span, and a shrimp, *Antrimpos speciosus* (von Munster), 7 inches long.

D.H.C.

Fine examples of portrait miniatures come on the market only occasionally; and so the European Department was pleased to be able to purchase the snuff box illustrated here when it recently became available. It is of tortoise-shell with an inset portrait painted in enamels on copper. The man can be identified as the aged William III, King of Great Britain and Holland, copied from a portrait by Sir Godfrey Kneller. The box and enamel are of good quality and may be attributable to Charles Boit (1663-1727), who was appointed portrait painter in miniature to William of Orange in 1696. A monogram inside the cover and a tiny moth on the bottom are created in piqué work, sections of gold wire inlaid in the tortoise-shell. This technique was popular with jewellers of the early 18th century. Boit left England about 1714 and travelled on the Continent where he achieved great success as a painter in enamels. Thus our box may be dated to c. 1696-1714. As a snuff box and as a fine portrait miniature, this object is a desirable addition to the collections of the Royal Ontario Museum.

C.P.K.

Completed in 1823 by the donor's great-great-grandmother, Sophia Pear, at the age of 13 at Atherley House of Apperley, Gloucestershire, this charming sampler is an excellent addition to the ever-growing collection of English embroideries (see K. B. Brett, *English Embroidery in the Royal Ontario Museum*, 1972). Worked on worsted tammy cloth in coloured silks with cross stitches, our example is adorned with a brick house flanked by trees and decorous verses fitted into a strictly symmetrical composition within a strawberry border frame. This type of design is characteristic of samplers from the second half of the 18th to the mid-19th centuries, and was conceived as an elementary exercise in the art of embroidery. As the first effort of a young embroideress, the sampler was designed to be looked at, admired, and framed, rather than as a collection of patterns and stitches, as was the case earlier. Gift of Mrs. Sylvia J. R. Clayton.

English sampler, 1823.

V.G.

Underside of a freshwater mite, Torrenticola elliptica *Maglio, from a river in Germany. Viets Collection.*

One hundred and three lots of aquatic mites of considerable historical and taxonomic value have been obtained from Germany by the Department of Entomology and Invertebrate Zoology. Most specimens are from the collection of Karl Viets, dating from his pioneer study (1936) of German water mites, and all identifications have been recently verified by Kurt O. Viets, a world authority on the group. The ROM houses the largest institutional collection of water mites in North America, which contains an abundance of basic information for the study of freshwater ecosystems. Full utilization of the research potential of our own collections has been hampered, however, by the uncertain relationship of many North American species and their European counterparts. With the addition of the Viets collection, a large selection of well-documented material from both sides of the Atlantic is available for the first time for comparative study.

D.B.

The Dust of Life

Pollen in Close-up

Reg Adams

Photographs by the author

Pollen grains are the male cells produced within the anther of a flower. Their primary function is to fertilize the ovules of a flower of the same species so that it can produce seed. The pollen of different families, genera, and species varies in size, shape, and ornamentation. Under some conditions pollen walls are almost indestructible. When buried in bog or lake mud, these pollen walls fossilize and remain recognizable for many thousands or even millions of years.

Palynologists (scientists who study pollen) are able to take a core of mud from the bottom of a bog or lake, take small samples at regular intervals from the top to the bottom of the core, and treat the samples to dissolve sand, clay, and organic matter. This treatment yields concentrations of almost pure pollen. The concentrate is then suspended in silicon oil and smeared on a microscope slide. The slide is scanned through the light microscope at 400 times magnification, and the pollen grains are identified and counted. The changes in percentages of different pollen types enable the palynologist to reconstruct the plant cover through time for the area around the coring site, as it existed when the pollen was deposited in the accumulating mud.

The study of pollen reveals information useful to many scientific disciplines. Not only can it help establish the taxonomic relationships among plants, but it can also aid in dating the age of rocks. From fossil pollen archaeologists can discover what crops were cultivated by prehistoric man, how he modified the vegetation, and even what foods he ate.

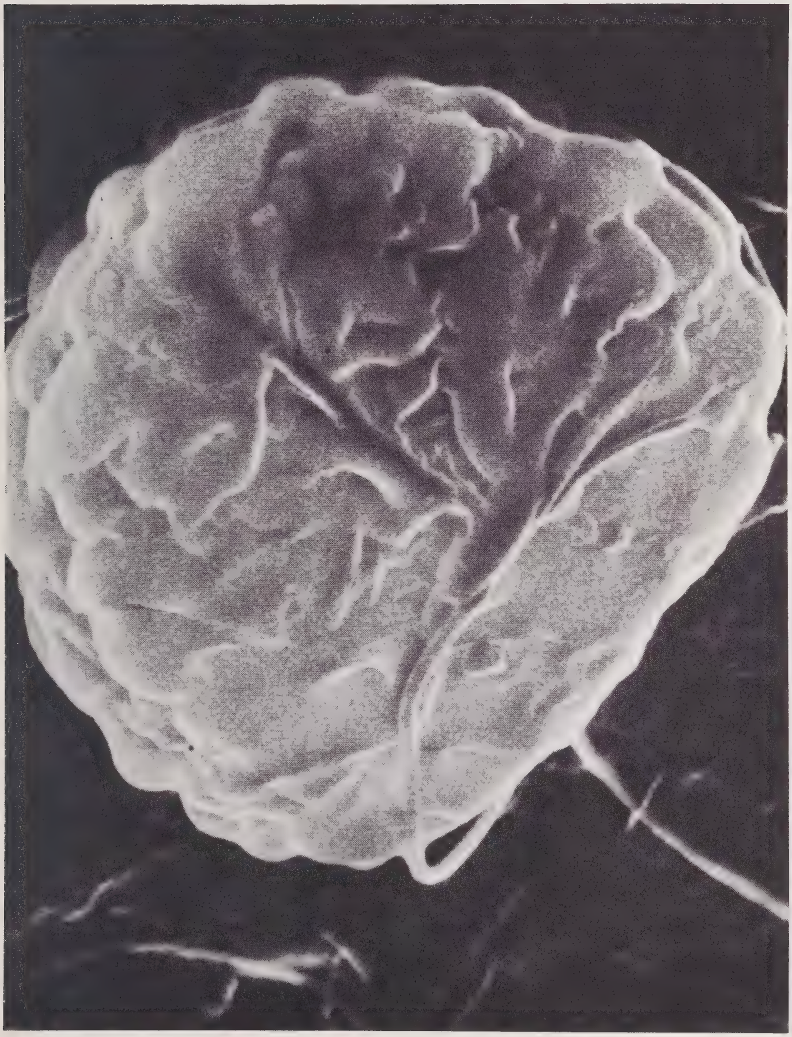
Palynology can also identify those plants that cause the miseries of hay fever. If you are among this band of sufferers, now is your opportunity to take a close look at your tormentor.

All of these pictures were taken on the scanning electron microscope (SEM), which allows us to see the various kinds of pollen in much greater detail than is possible on the light microscope. All but the last two pictures appear in *An Atlas of Pollen of the Trees and Shrubs of Eastern Canada and the Adjacent United States* by R. J. Adams and J. K. Morton, published in the University of Waterloo biology series.

Magic Formula to Make an Enemy Peaceful

Put your feet down with pollen.
Put your hands down with pollen.
Put your head down with pollen.
Then your feet are pollen;
Your hands are pollen;
Your body is pollen;
Your mind is pollen;
Your voice is pollen.
The trail is beautiful.
Be still.

Navajo

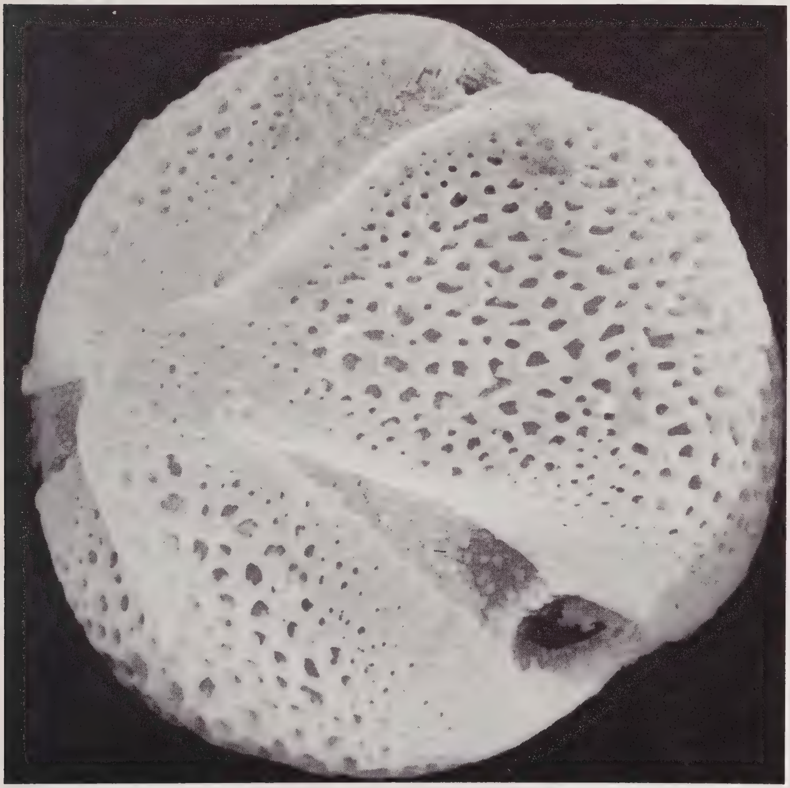


Rattlesnake Fern *(Botrychium virginianum)* x 5500
To begin an article about pollen with a picture of a fern spore may seem strange, but the functions of the two are quite similar. The spore is a primitive sort of seed, while the pollen carries the male function (sperm) to fertilize the ovule, from which the seed of a higher plant is produced. The outer wall or exine of both spores and pollen is made up of an almost indestructible waxy material called sporopollenin. Both pollen and spores are found in bog and lake sediments, still perfectly recognizable after some millions of years. Unlike pollen, some fern spores have an outside sac called a perine, and many of them have a trilete scar, the large inverted T you see here.

White Pine *(Pinus strobus)* x 1900
The pollen grain of the white pine, like that of the other pines, spruces, and firs, has a body and two bladders. These species are wind pollinated, and the bladders make the pollen grains more buoyant; they are sometimes carried by the wind for many hundreds of miles. You will notice that the underside of this pollen grain, between the bladders, is covered with small knobs or warts, often called "belly warts". These warts distinguish the white pine pollen from other species of pine pollen.

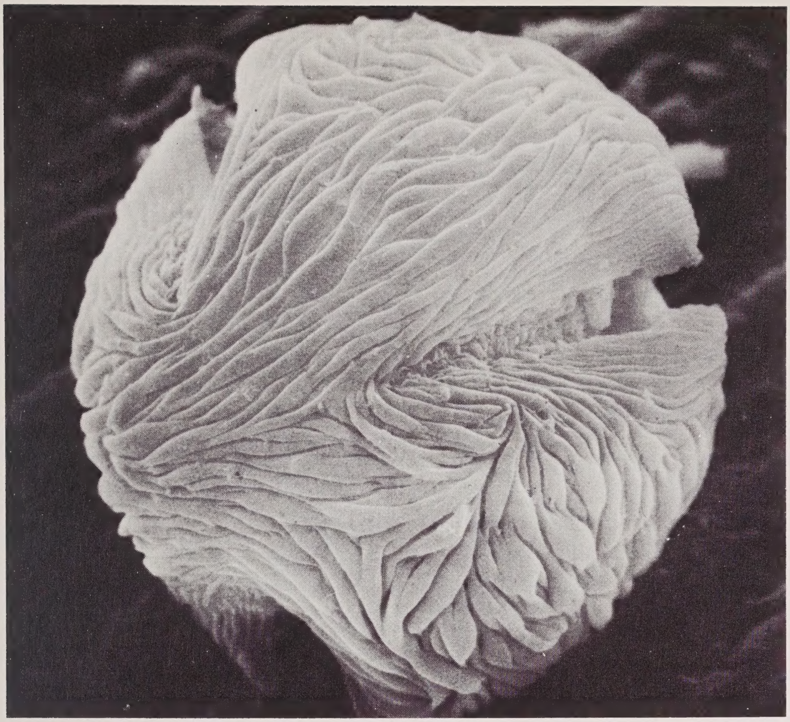
White Birch *(Betula papyrifera)* x 4000
This picture and the ones that follow show the pollen of some of our broad-leaved trees, shrubs, and herbs. White birch pollen has three pores, through which the sperm passes on the way to fertilize the ovule. At a smaller magnification the surface would appear smooth, but at this magnification it is seen to be covered with tiny granules.

Magnolia *(Magnolia macrophylla)* x 2100
Magnolia pollen has one furrow that functions as a passage for sperm. Pollen with only one furrow is quite rare, but it is also found in the lily, waterlily, and fern families. The surface of this pollen grain is almost smooth, though a slight texture can be seen in this photomicrograph.

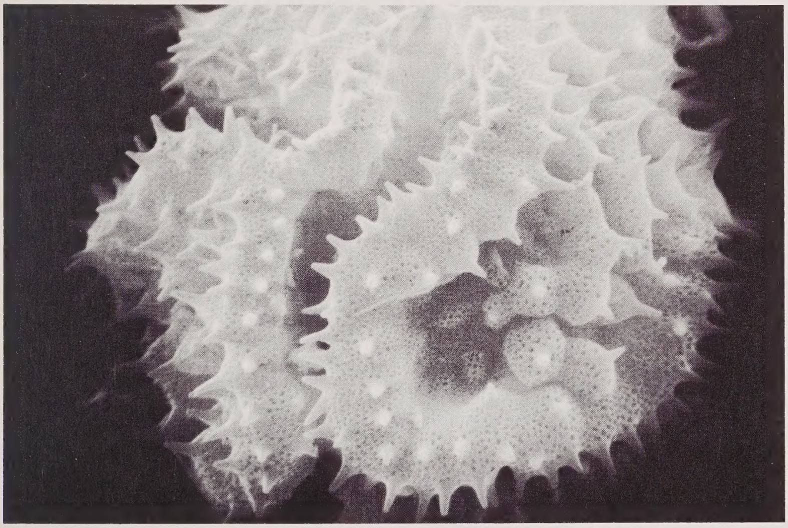


Virginia Creeper *(Parthenocissus vitaceae)* x 3900
Virginia creeper belongs to the grape family. Its pollen has three furrows, with a pore in the centre of each furrow. Three-furrowed pollen is probably the most common type of pollen in the plant kingdom. In this picture you can see that the pits dotting the pollen grain become smaller as they approach the furrows and the ends of the grain, called the poles.

Dwarf Dandelion *(Krigia oppositifolia)* x 6900
This is truly a pollen grain, not the masked bandit that it appears to be. It belongs in the aster or sunflower family, the Compositae. This is by far the largest family in the plant kingdom, containing more than 15,000 species. Some of the more famous members of this family are the ragweed, dandelion, and thistle. The pollen of this family all have spines arranged in a variety of patterns. Here, then, is the villain that makes your nose run and your eyes water.



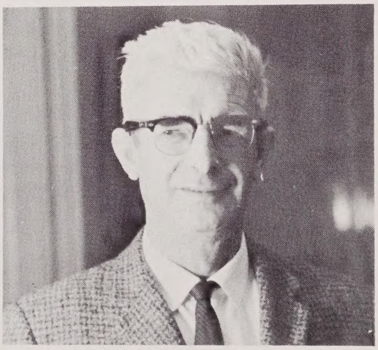
Beach Plum *(Prunus maritima)* x 3400
The beach plum, another three-furrowed pollen grain, belongs to the rose family. This very large family contains many of our fruits—apples, pears, cherries, raspberries, and strawberries—as well as roses. Most pollen grains of this family are similar to beach plum, whose surface is covered with parallel ridges called striae.



Reg Adams is a Field Associate of the ROM's Mineralogy and Geology Department. He has had careers as a farmer, nurseryman, and commercial photographer, and has been an enthusiastic botanist all his life. In 1975 he won first and third prizes for photomicrography given by the Canadian Botanical Association. He and Dr. Jock McAndrews of the ROM are currently collaborating on a study of the fossil pollen and vegetation history of Ontario.

The photographs for this article were made at the Biology Department of the University of Waterloo, where the author worked with Dr. J. K. Morton.

Dandelion *(Taraxicum officinale)* x 2500
The dandelion belongs in a relatively small group of plants, quite unrelated to one another, that produce seed without fertilization by pollen. And so, although some dandelion pollen grains are fertile, most are not. The production of seeds without fertilization is called apomixis. Other apomictic plants include some of the hawthorns and at lease one species of coffee, *Coffea arabica*. The pollen of these species is also atypical; instead of having three furrows it may have four, five, or more. As you can see, the dandelion pollen is irregular and is quite different from the dwarf dandelion pollen. So I give you the dandelion pollen, beautiful but not quite reliable.



Recent Publications

Man in Nature: Historical Perspectives on Man in His Environment, *edited by Louis D. Levine,* ROM, pp. 133, ill. b.&w., $3.95 paper
In this stimulating collection of seven essays, illustrated with maps and photographs, ROM staff members explore the relationships between past human cultures and their natural environments. With timely relevance for modern Western society, they show how problems of over-population and exhaustion of natural resources were met or avoided by other civilizations and peoples. The cultures investigated are Prehistoric Near Eastern, Ancient Egyptian, Greek, Chinese, North American Indian, and Mesoamerican Maya.

Quetico Fishes, *E. J. Crossman,* ROM/Quetico Foundation, Life Sciences Miscellaneous Publication, pp. 86, ill. b.&w., $3.00 paper
A complete guide to the fishes of Quetico Provincial Park, resulting from an intensive survey carried out between 1967 and 1973. Each species found in the park is illustrated and described according to means of recognition, distribution in the park, habitat, average size, size-age-weight relationships, food, and spawning habits. Also included are distribution lists by species and by the bodies of water in which each fish is found, and a chapter on the history of Quetico fishes.

Tokens of Possession: The Northern Voyages of Martin Frobisher, *W. A. Kenyon,* ROM, pp. 164, ill. b.&w. and colour, $4.95 paper
In 1576, Martin Frobisher sailed from Blackwall, near London, on the first of his three voyages of Arctic exploration. To mark the 400th anniversary of the event, Dr. Walter Kenyon has produced this new edition in lively modern English of the journals of the three voyages kept by George Best, one of Frobisher's captains. To supplement Best's exciting narratives of adventure and endurance Dr. Kenyon has provided a historical introduction and an account of an archaeological expedition—"Frobisher IV"—which he himself led to Frobisher Bay in 1974. The purpose of Frobisher IV was to see what traces were still to be found of Frobisher's expeditions to the region, from which, in spite of high hopes, all that he brought back were an Eskimo, his kayak, and some pieces of rock as "tokens of possession".

Redescription of Type Specimens of Species of the Bryozoan Genera Monticulipora, Mesotrypa, Peronopora, and Prasopora, from the Upper Ordovician Rocks of Toronto and Vicinity, Ontario, Canada, ROM Life Sciences Contribution 107, *Madeleine A. Fritz,* pp. ii + 24, illustrated, $1.50

Revision of Conodont Biofacies Nomenclature and Interpretations of Environmental Controls in Pennsylvanian Rocks of Eastern and Central North America, ROM Life Sciences Contribution 108, *Glen K. Merrill and Peter H. von Bitter,* pp. vi + 46, illustrated, $2.50

The Apparatus of *Gondolella sublanceolata* **Gunnell (Conodontophorida, Upper Pennsylvanian) and its Relationship to** *Illinella typica* **Rhodes,** ROM Life Sciences Contribution 109, *Peter H. Von Bitter,* pp. iv + 44, illustrated, $2.25

Sir Martin Frobisher. Courtesy of the Bodleian Library, Oxford.

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